

INDUCTIVE METHODS OF TEACHING.

ANATOMY PHYSIOLOGY
AND
HYGIENE

With special reference to the effects of
stimulants and narcotics.

FOR USE IN PRIMARY AND INTERMEDIATE SCHOOLS.

BY

CHARLES H. MAY, M.D.,

Chief of Eye-Clinic and Instructor in Ophthalmology, College of Physicians and Surgeons,
Medical Department, Columbia College, N. Y.; Assistant Surgeon N. Y. Ophthalmic
and Aural Institute; Fellow of the N. Y. Academy of Medicine, etc.

THIRD EDITION, REVISED AND ENLARGED.

PROFUSELY ILLUSTRATED BY ENGRAVINGS IN BLACK
AND COLORS.

COPIES WILL BE SENT TO TEACHERS, ETC., FOR EXAMINATION,
AT INTRODUCTION RATES.

WILLIAM WOOD & COMPANY, PUBLISHERS,
NEW YORK.

A TEXT-BOOK
ON
PHYSICS

BEING A SHORT AND COMPLETE COURSE

BASED UPON THE LARGER WORK OF GANOT.

For the Use of Academies, High Schools, etc.

BY

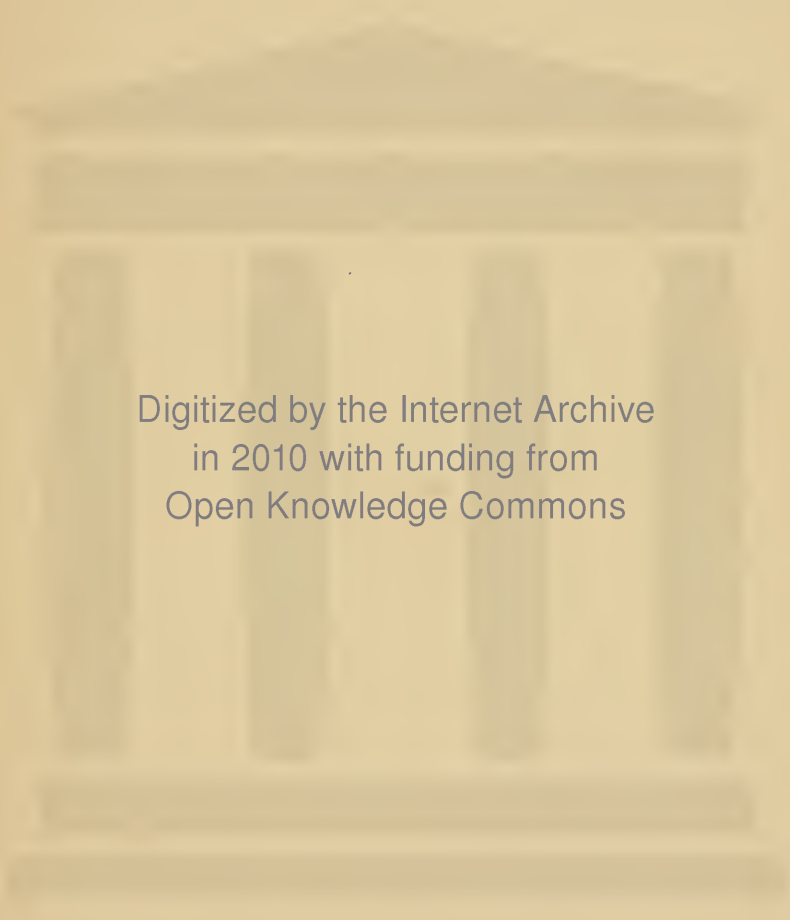
HENRY KIDDLE, A.M.,

LATE SUPERINTENDENT OF SCHOOLS, NEW YORK CITY.

Illustrated by Three Colored Plates and a Large Number
of Woodcuts.

A NEW AND IMPROVED EDITION.

WILLIAM WOOD & COMPANY, PUBLISHERS,
NEW YORK.



Digitized by the Internet Archive
in 2010 with funding from
Open Knowledge Commons

PRIMARY PHYSIOLOGY

AND

HYGIENE

BY

CHARLES H. MAY, M.D.

*Chief-of-Clinic, Eye Department, Vanderbilt Clinic, and Instructor in Ophthalmology,
College of Physicians and Surgeons, Medical Department of Columbia Uni-
versity, New York; Professor of Diseases of the Eye and Ear, College
of Physicians and Surgeons, Boston, Mass.; Fellow of the
Academy of Medicine, New York, etc., etc.*

WILLIAM WOOD AND COMPANY
NEW YORK

Spec Coll
Hist Coll
BP
36
.M291
1896

COPYRIGHT, 1896, BY
WILLIAM WOOD AND COMPANY

TROW DIRECTORS
PRINTING AND BOOKBINDING COMPANY
NEW YORK

PREFACE.

IN the following pages the author has endeavored to present an elementary account of the different parts of the human body and the manner in which they perform their work—that of living. This serves as a basis for the instruction given in the care of the body.

As is well known, a great deal of ill-health and many diseases can be avoided by the exercise of care. Instruction in the fundamental rules which govern the selection of food, proper and sufficient exercise, ventilation, and the correct use of the various functions of the body will result in a tendency to increase the health and strength of children. Knowledge of this sort, if elementary and simple, can be acquired by children, and is productive of much benefit in after life.

Though the simplest possible language has been employed, and elementary facts only have been presented, “baby talk” has been carefully avoided. There is no good reason for teaching anatomy, physiology, and hygiene in this very objectionable but very common manner; certainly no more than applies to arithmetic or geography. Such an objectionable

style arouses in young minds a suspicion that the matter is frivolous or unimportant, or else beyond their reach, and hence requiring a coating or disguise.

The author has attempted a scientific presentation, given in the simplest terms compatible with clearness and within the power of comprehension of children in the primary grade of public and private schools.

CHARLES H. MAY, M.D.

692 MADISON AVENUE, New York,
August 1, 1896.

CONTENTS.

LESSON	PAGE
I. Introduction, ...	1
II. The Parts of the Body, ...	5
III. The Framework or Skeleton, ...	9
IV. The Parts of the Skeleton, ...	13
V. The Care of the Skeleton, ...	19
VI. The Joints, ...	24
VII. How the Different Parts of the Body are Moved.—The Muscles, ...	29
VIII. The Care of Muscles.—Exercise, ...	35
IX. Calisthenics, ...	39
X. Growth and Repair, ...	45
XI. The Food of Plants and Animals, ...	48
XII. Our Food, ...	51
XIII. The Water which We Drink, ...	56
XIV. How the Food is Changed in the Stomach, ...	61
XV. The Final Changes in the Food so that it can Mix with the Blood.—The Intestines and Liver, ...	69
XVI. How to Enjoy Good Digestion, ...	74
XVII. Life's Fluid.—The Blood, ...	77
XVIII. How the Blood is Forced Through the Body.—The Heart and Blood-Vessels, ...	83

LESSON	PAGE
XIX. The Voice.—How We Produce Sounds and Talk, .	92
XX. Breathing.—The Windpipe and Lungs, . . .	95
XXI. How the Air is Purified.—Fresh Air.—Ventilation, .	102
XXII. Our Outside Covering.—The Skin, ...	106
XXIII. The Care of the Skin.—Bathing, ...	111
XXIV. The Warmth of the Body.—Our Clothing, . .	114
XXV. Alcoholic and Other Stimulants, ...	117
XXVI. Alcohol, ...	119
XXVII. Fermentation, ...	122
XXVIII. Alcoholic Drinks, ...	125
XXIX. The Effects of Alcoholic Drink Upon the Body, .	131
XXX. The Effects of Alcoholic Drink Upon the Different Parts of the Body, ...	135
XXXI. Other Harm which Alcoholic Drink Causes, . .	138
XXXII. Narcotics.—Tobacco, ...	141
XXXIII. Opium and Morphine, ...	147
XXXIV. The Brain, Spinal Cord, and Nerves, . . .	151
XXXV. The Work of the Brain, Spinal Cord, and Nerves, .	157
XXXVI. The Five Senses.—The Sense of Sight.—The Eye, .	161
XXXVII. The Care of the Eyes, ...	165
XXXVIII. The Sense of Hearing.—The Ear, ...	168
XXXIX. The Sense of Smell.—The Nose, ...	172
XL. The Sense of Taste.—The Tongue, ...	175

LESSON I.

INTRODUCTION.

1. Good health is the greatest blessing. You may not agree with us, until you have thought over the matter and considered of how little value all else is if we are feeble and sickly. You may envy those who are wealthy, who have done great deeds, and those who have acquired much knowledge. But with good health everything else is possible; without it, the chances are against us. Have you ever known some child who, although surrounded by every comfort and every luxury which money can buy, sighs for one short day of well-being and would willingly give everything for good health? Such cases are very common.

2. In order to properly care for anything, we must know something of how it is put together; and if we are going to understand how to take care of ourselves, we must know something of the form and structure of the different parts of our bodies; this study is called **ANATOMY**.

3. The study of how we live and how the different parts of the body act and do their work is called **PHYSIOLOGY**. It explains what becomes of our food, how our blood flows, how we breathe, grow, and move, and do the many things necessary to life.

4. The study of how to take care of the body and how to prevent sickness is called *HYGIENE*. It is a very important subject. "An ounce of prevention is worth a pound of cure" is an old saying, and is certainly a true one. If we wish to avoid sickness, we must keep our bodies healthy. In order to know how to do this we must learn about the things around us which are harmful and poisonous, so as to avoid them; we must study what is good and what is improper in our food, what are bad habits to be avoided, and also the bad effects of drinks containing alcohol and of tobacco. All these things *Hygiene* teaches us.

5. But if we are to remember them, we must understand how and why it is that certain things and habits are injurious; and to do this we must know something about the structure of the body—*Anatomy*, and the manner in which it does its work—*Physiology*. These three branches—Anatomy, Physiology, and Hygiene—are known by rather long names. Let us see whether we cannot make them easy and simple by taking an example:

6. Suppose a man wishes to be an engineer upon a locomotive. To perform his duties well, there are many things connected with the locomotive which he must know. In the first place, he must understand the different parts of which it is built and how it is put together. This would be the same as the study of Anatomy in the human being.

7. Again, he must understand how the locomotive works—what causes the wheels to go round, how steam is produced, how to attend to the fire, how to

put on the brakes, and how to make this great machine go faster or slower. This we would liken to the study of Physiology in the human being.

8. Finally, such an engineer must be acquainted with the proper care of his locomotive—what fuel to use and how much of it, how to keep the different parts clean and oiled, and other things to keep it from getting out of order. Similar knowledge applied to the human body is called Hygiene.

QUESTIONS.

1. What can you say concerning the possession of good health?
2. What is anatomy?
3. What does physiology teach us?
4. What is hygiene?
5. What are some of the things which it teaches us?
6. Explain the differences between these three branches: anatomy, physiology, and hygiene?

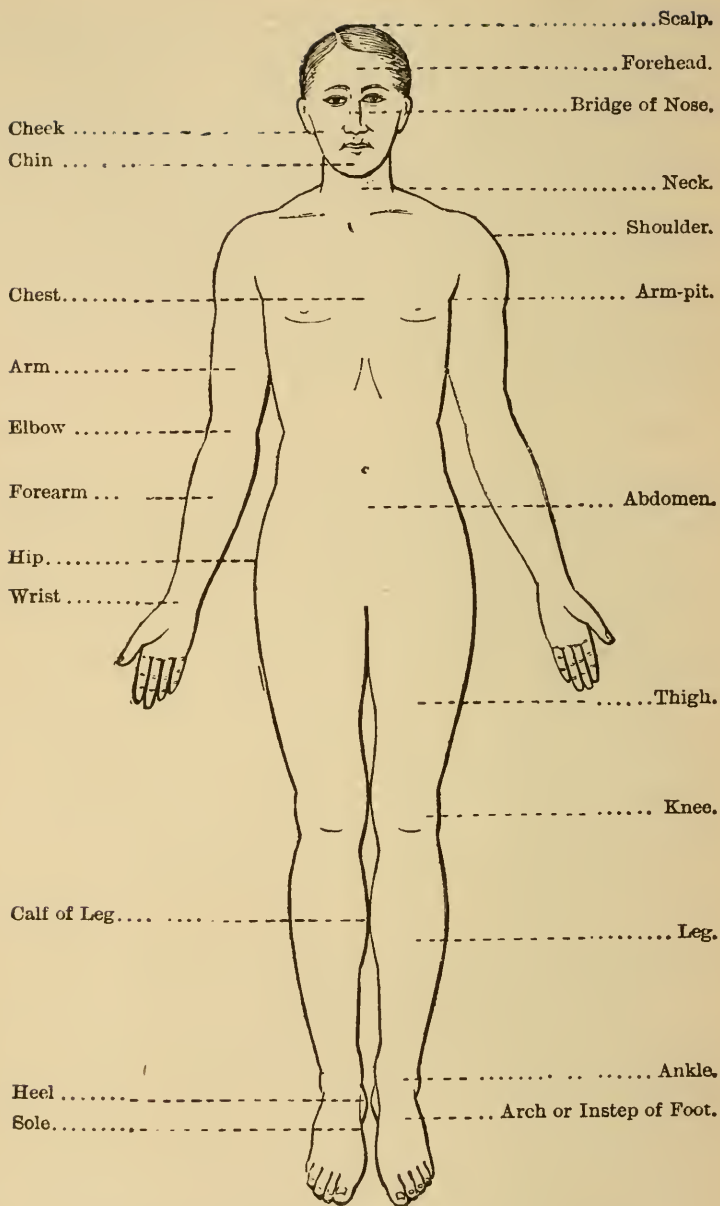


FIG. 1.—The Names of Different Parts of the Body.

LESSON II.

THE PARTS OF THE BODY.

9. The body may be divided into different parts. These are the *trunk*, *the head*, and *the limbs*.

10. **The Trunk.**—The *trunk* is that part of the body between the head and upper limbs above, and the lower limbs below. The main part of a tree is called the trunk, and similarly the principal part of the body is called by the same name. It consists of a number of bones which help to form two large spaces (Fig. 64): an upper one, the *chest*, which holds the heart and lungs; and a lower one, the *abdomen*, for the parts in which the food is changed so that it can be taken up by the blood.

11. **An Organ of the Body.**—We will frequently make use of the word “*organ*.” As applied to our bodies, it means a part which does some special work. For instance, the stomach is one of the organs which change the food into a liquid form; the eye is the part with which we see, hence it is called the organ of sight; with the tongue we taste our food, hence it is called the organ of taste.

12. **The Head.**—The *head* is formed of a number of flat bones which meet to enclose a large space for the brain, and several smaller ones to receive the eyes, ears, nose, and tongue.

13. **The Upper Limbs.**—The *upper limbs* start from the shoulders, at the upper part of the trunk. There are two upper limbs, a *right* and a *left*. Each consists of the *arm*, the *forearm*, and the *hand*. Where the upper limb joins the trunk is the *shoulder*. Where the arm and forearm meet is the *elbow*. Where the forearm and hand meet is the *wrist*. The front of the

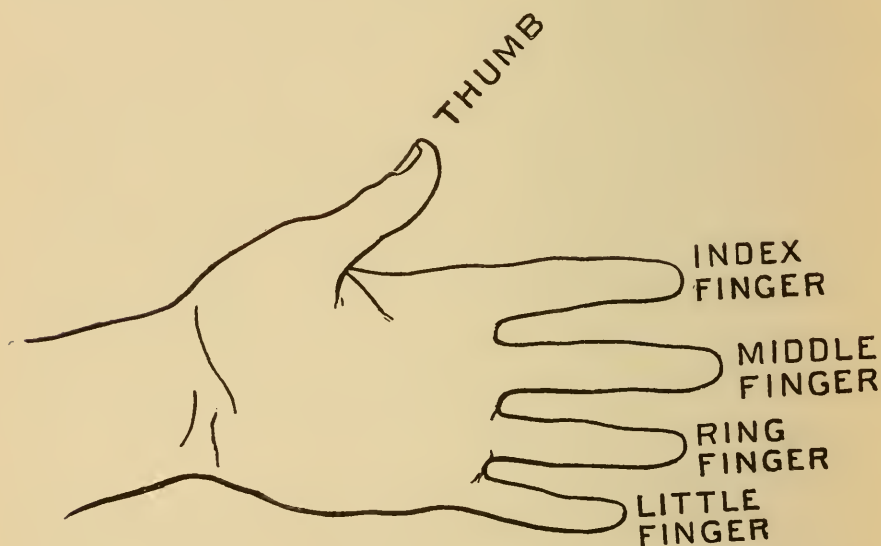


FIG. 2.—The Hand, with Names of Fingers.

hand is called the *palm*, the opposite side, the *back of the hand*.

14. **The Fingers.**—Attached to each hand are five fingers (Fig. 2) ; these are named as follows :

The first, which is short and thick, is the *thumb*.

The second, the *index finger*.

The third, the *middle finger*.

The fourth, the *ring finger*.

The fifth, the *little finger*.

15. **The Lower Limbs.**—The *lower limbs* start from the lower part of the trunk. There are two lower limbs, a *right* and a *left*. Where the lower limbs join the trunk is the *hip*. Each lower limb consists of a *thigh*, a *leg*, and a *foot*. Where the leg and thigh meet is the *knee*. Where the leg and foot meet is the *ankle*. The under surface of the foot which touches the ground is called the *sole*; the upper surface is called the *instep*.

QUESTIONS.

1. Into what three main parts do we divide the body? 2. What is the trunk? 3. What large spaces does it contain? 4. What parts are found in the chest? 5. What parts are found in the abdomen? 6. What is an organ of the body? 7. Give examples of organs in the human body. 8. How is the head formed? 9. Name the parts of which each upper limb consists. 10. Where is the shoulder? 11. Where is the elbow? 12. What is meant by the palm of the hand? 13. Give the names of the five fingers, pointing to each one upon your own hand. 14. Name the parts of which each lower limb consists. 15. Where is the hip? 16. Where is the knee? 17. Where is the ankle? 18. Which part of the foot is called the sole? 19. Which part of the foot is called the instep?

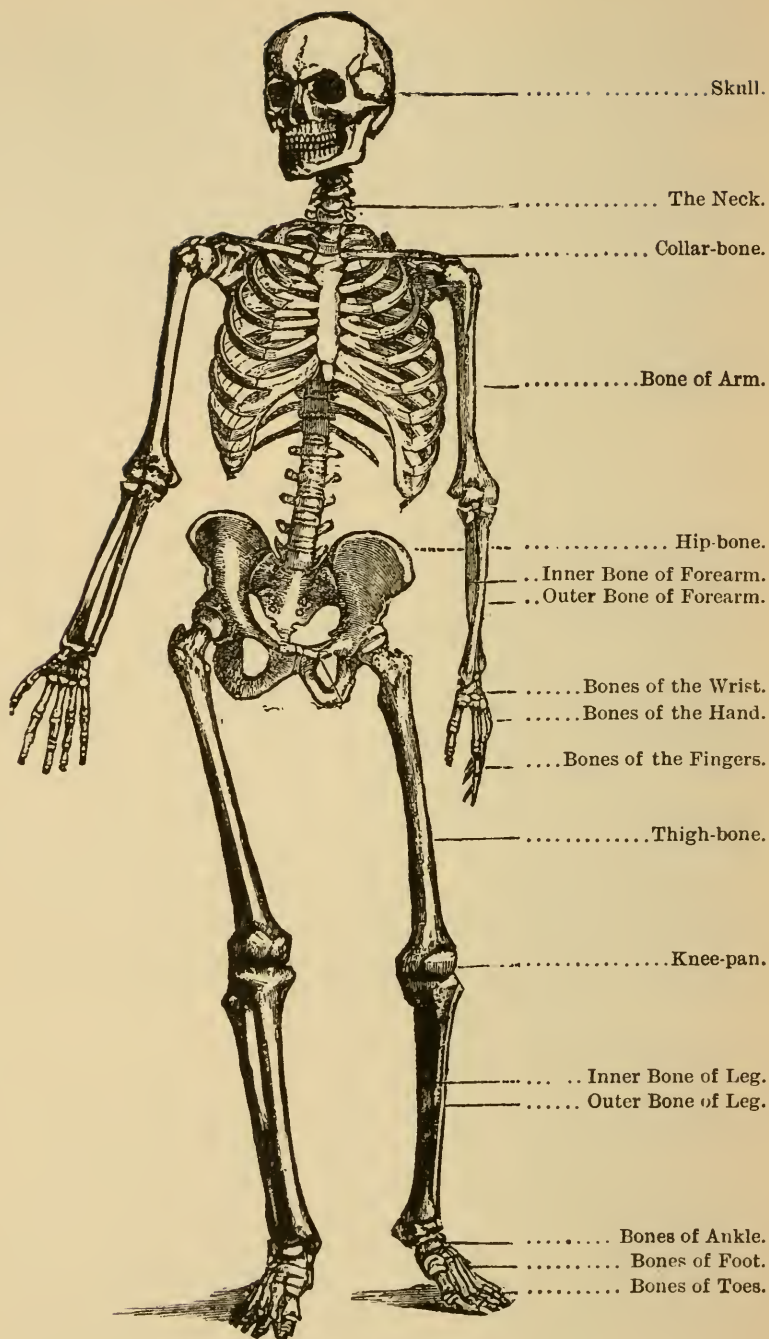


Fig. 3.—The Framework or Skeleton.

LESSON III.

THE FRAMEWORK OR SKELETON.

16. If you watch a building from the time it is begun until it is finished, you will notice that the foundation is laid first; then strong pillars and beams are put in place, and the other parts of the house are built around these. If you inquired of the builder what these were for, he would tell you for *support and strength*.

17. In our own bodies there is a similar arrangement formed of bones; this is our *framework or skeleton*. The skeleton is the name given to all the bones of the body taken together. They form a framework around which all the soft parts are arranged; in some parts of the body they serve as coverings to protect important organs, such as the brain, the heart, and the lungs.

18. **The Uses of Bones.**—The uses of bones are :

First, to give the body *support* and to keep it *erect*.

This we see especially in the bones of the lower limbs, and in the column of small bones placed one upon the other, which we speak of as the backbone.

Second, to *protect* certain parts from injury. The brain, for instance, is enclosed in a sort of oval

box formed by a number of flat bones joined together.

Third, to give great *strength*. In the foot, for instance, there are many small bones, so arranged that they are strong enough to bear the weight of the body in walking and jumping.

Fourth, for *motion*. We see examples of such use in walking, running, in grasping objects, and in the great many different ways in which our limbs can be moved. All this is done by means of fleshy bundles called muscles ; these are fastened to the bones and pull them in different directions.

19. There are two hundred bones in the human body. They *vary in size and form*. Some are quite small and others are of good size. Some are long, as the thigh-bones ; others are small and short, such as the bones

of the wrist ; others are flat, as, for example, the bones forming the skull.



FIG. 4.—A Thin Slice of Bone, showing the Spaces, as seen under the Microscope.

20. Bone appears to be solid, but in reality it has a great many very small *spaces* in it (Fig. 4). On the outside is a very hard layer, but within, there is a large number of spaces through

which the little vessels which carry the blood run. The long bones, as those of the arm, thigh, and fingers, are hollowed out in the centre, and in this space we find a fatty substance called *marrow*.

21. Bones are of a pink color during life, on account of the blood which they contain ; when dead, the color of bone changes to white.

22. **Lime.**—The hardness of bone is due to a mineral substance called *lime*. You have doubtless often seen lime used in making plaster and mortar for the walls of houses.

23. In the bones of the baby there is very little of this lime present, and this is the reason why the baby cannot stand ; if allowed to stand too soon, the bones of the legs may become bent, because they are not yet hard enough to bear the weight of the body ; gradually, as the baby grows, the hard matter is added.

24. In young persons the bones have sufficient lime, so that they will not bend. They are always softer than in the aged, and therefore do not break so easily. For this reason boys and girls may receive knocks and falls, and may tumble about in play, without injury to the bones.

25. In old persons there is more lime, and the bones become more brittle than in youth ; hence such bones are more easily broken, or, as the doctor would say, are more liable to *fracture*.

QUESTIONS.

1. What is meant by the word skeleton ? 2. Why is it necessary to have a skeleton ? 3. What are the different uses of bones ? 4. Give examples of the uses of bones. 5. How many bones are there in the human body ? 6. How do bones vary in size and form ? 7. Is bone perfectly solid ? 8. Which part of the bone is the most solid ? 9. How does the inner part of the bone differ from the

outer layer? 10. What is marrow? 11. What is the color of bone during life? 12. What is the hardness of bone due to? 13. What is peculiar about the bones of the baby? 14. Why do they bend easily? 15. How do the bones of young persons differ from those of old persons? 16. What is a fracture?

LESSON IV.

THE PARTS OF THE SKELETON.

26. We may divide the skeleton into four parts:
- (1.) Bones of the head.
 - (2.) Bones of the trunk.
 - (3.) Bones of the upper limbs.
 - (4.) Bones of the lower limbs.

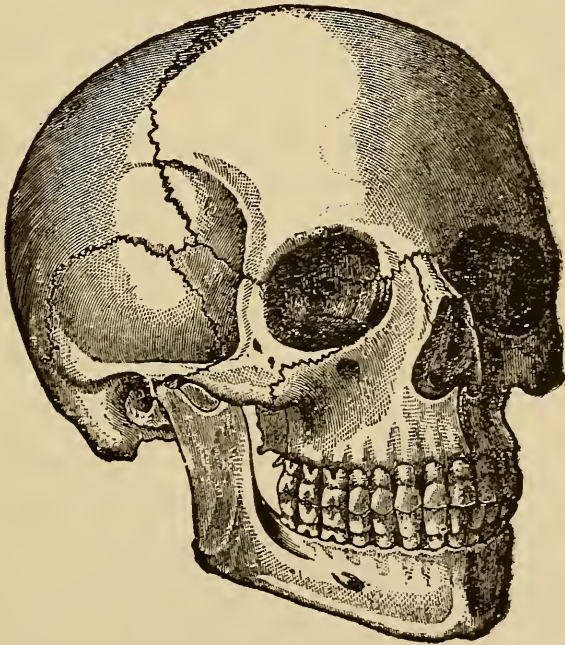


FIG. 5.—The Skull.

27. **Bones of the Head.**—The bones of the head taken together form the *skull* (Fig. 5). The upper and back part of the skull forms an oval box in which

the brain is contained. The rest of the skull, seen in front, forms the *face*.

28. At the upper part of the face is the *forehead*. Just below this part of the skull we see two large openings for the *eyes*; below and between these is the opening for the *nose*. At the lowest part of the face are the two *jaws*, the upper and the lower; each jaw has a row of teeth attached to it, and between these is the *mouth*.

29. The skull rests upon the upper end of the backbone (Fig. 3), and is very movable, so that it can be turned in any direction.

30. **The Bones of the Trunk.**—

The bones of the trunk are the backbone behind, the collar-bones above and in front, the shoulder-blades above and behind, the breast-bone in front, the ribs on either side, and the hip-bones below.

31. *The Backbone* (Fig. 6) consists of a large number of small bones placed one on top of the other, forming a column along the middle of the back and joined to the skull above; we can bend and twist it in any direction. If you

run your finger along the middle of the back, you can feel the ends of the bones of which the backbone is formed.

32. *The Collar-bones* (Fig. 7, C) are the curved bones



FIG. 6.—The Backbone.

which you can feel at the upper part of the chest in front.

33. *The Shoulder-blades* (Fig. 7, *S*) are the large flat bones which we feel at the upper part of the chest behind.

34. *The Breast-bone* (Fig. 9) is a flat bone which forms a strong guard to the front of the chest. Along its edges the ribs are attached on each side.

35. *The Ribs* (Fig. 9). There are twenty-four ribs, twelve on each side. They are long, slender, curved bones which form the outer boundary of the chest, being joined to the backbone behind, and most of them to the breast-bone in front. In this way the *chest* is formed.

36. Below, the chest is separated by a flat sheet of muscle (Fig. 64) from another space called the *abdomen*.

37. *The Hip-bones* (Fig. 8, *H*) are two large and strong bones placed be-

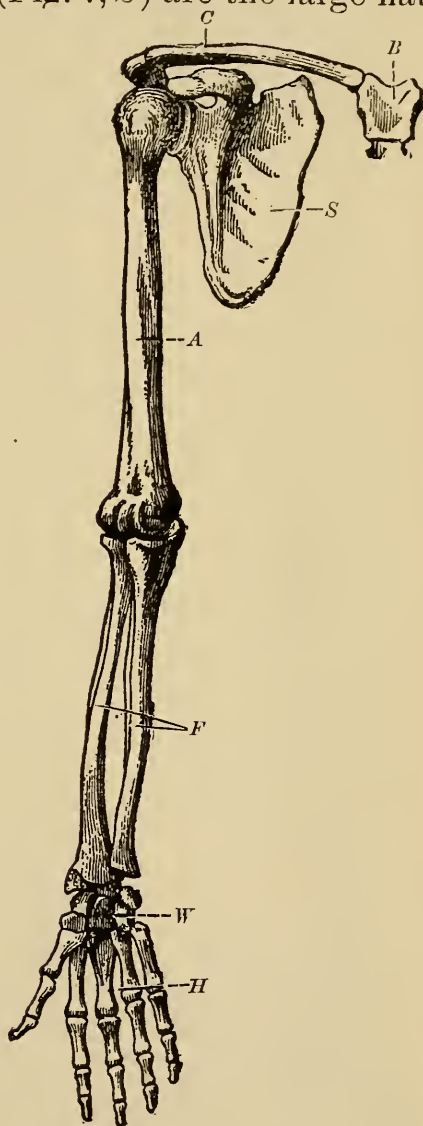


FIG. 7. — The Bones of the Upper Limb. *B*, Breast-bone; *C*, Collar-bone; *S*, Shoulder-blade; *A*, Bone of Arm; *F*, Bones of Forearm; *W*, Bones of Wrist; *H*, Bones of Hand.

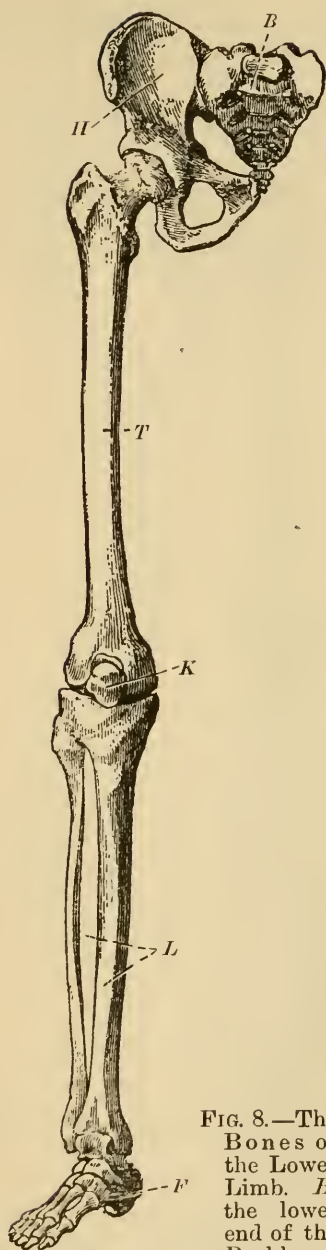


FIG. 8.—The Bones of the Lower Limb. *B*, the lower end of the Backbone; *H*, the Hip-bone; *T*, the Thigh-bone; *K*, the Knee-pan; *L*, the Bones of the Leg; *F*, the Bones of the Foot.

H, the Hip-bone; *T*, the Thigh-bone; *K*, the Knee-pan; *L*, the Bones of the Leg; *F*, the Bones of the Foot.

tween the lower end of the back bone and the upper ends of the thigh-bones.

38. **The Bones of the Upper Limb.**—These are the bone of the arm, the two bones of the forearm, and the small bones forming the wrist and hand.

39. *The Bone of the Arm* (Fig. 7, *A*) is a strong, single bone which extends from the shoulder to the elbow.

40. *The Bones of the Forearm* (Fig. 7, *F*). There are two bones in the forearm, placed side by side; they extend from the elbow to the wrist.

41. *The Bones of the Wrist and Hand* (Fig. 7, *W* and *H*). Each *hand* may be divided into the *wrist*, the *palm*, and the *fingers*. Each part is formed of a number of small bones; this arrangement gives great strength and allows us to move our fingers very freely.

42. **The Bones of the Lower Limb.**—These comprise the thigh-bone, the bones of the leg, the knee-pan and the bones of the foot.

43. *The Thigh-bone* (Fig. 8, *T*) is the largest and strongest bone in the body. It extends from the hip to the knee.

44. *The Knee-pan* (Fig. 8, *K*) is a small, round bone which can be felt at the knee; it protects this part and often saves it from injury in falls and blows.

45. *The Bones of the Leg* (Fig. 8, *L*). There are two bones in each leg; they are placed side by side from the knee to the ankle.

46. *The Bones of the Foot* (Fig. 8, *F*). Each foot is formed by a large number of small bones. In the back of the foot we feel a projecting part called the *heel*. Just in front of the ankle is the rounded part known as the *instep*. In front are the five *toes*. The *sole* of the foot, between the heel and the toes, forms an *arch* which breaks the force of jumps or shocks. In jumping from a height, we should alight upon the toes and upon the soft cushion just behind the toes known as the *ball of the foot*; when we reach the ground upon the heel, there is a disagreeable shock which is sent through the rest of the body and which may be injurious.

QUESTIONS.

1. Into what four parts can we divide the skeleton? 2. What is the skull? 3. Into what two parts can we divide the skull? 4. What openings are there in the skull? 5. What supports the skull? 6. Name the bones of the trunk. 7. Where is the back-bone? 8. How is the backbone formed? 9. Where is the collar-bone? 10. Where is the shoulder-blade? 11. Where is the breast-bone? 12. Where are the ribs? 13. How many ribs are there? 14. How is the chest bounded? 15. What cavity is there below

the chest? 16. Where are the hip-bones? 17. What bones are there in the upper limb? 18. How many bones are there in the arm? 19. How many in the forearm? 20. Into what parts can each hand be divided? 21. What bones are there in the lower limb? 22. Where is the thigh-bone? 23. How many bones are there in each leg? 24. Where is the knee-pan and what is its use? 25. Where is the heel? 26. Where is the instep of the foot? 27. What is meant by the sole of the foot? 28. In jumping from a height upon what part of the foot should we alight, and why?

LESSON V.

THE CARE OF THE SKELETON.

47. If we wish to have erect and graceful bodies when full-grown, we must take care of them while we are young. When growing, the bones are soft and easily shaped. The gardener will tell you that if he wants to change the growth of a tree and prevent its spreading in faulty ways, he must prop it up and bend it while it is young.

48. **Stand and Sit Erect, with the Chest Thrown Forward and the Shoulders Back.**—Even at our desks we must *sit up straight* (Figs. 96 and 97). When we read, the book must not be allowed to lie in the lap, for this tends to make us stoop; it must be held in the hand at about twelve inches from the face. If we cannot read at this distance we probably need glasses, and it will then be well to consult an oculist. Care to avoid these faults will *prevent stooping and round shoulders*.

49. Have you ever seen a regiment of soldiers marching through the avenue, upon some holiday, and noticed the fine, manly appearance which their straight, erect bearing gives them? Would you consider it such a fine sight if the soldiers were stooping, round-shouldered, and bent? Indeed not! You must all try to grow up to be well-built men and women, so

that you will have health and strength, and will each of you be able to add a little to the welfare of the world.

50. **Do not Wear Tight Clothing.**—Clothing is intended to keep us warm and to protect us, but not to press upon any part of the body. Girls often have

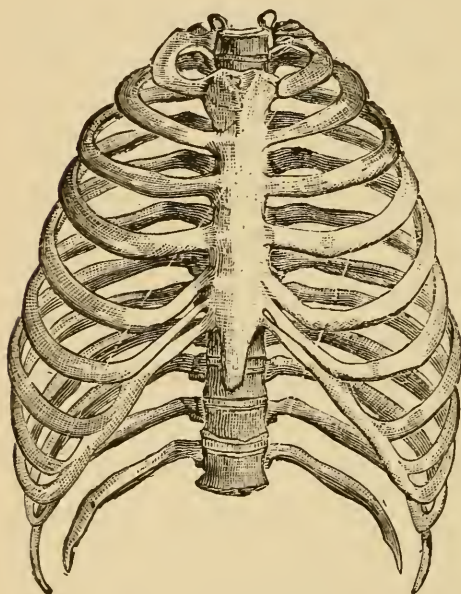


FIG. 9.—The Chest.

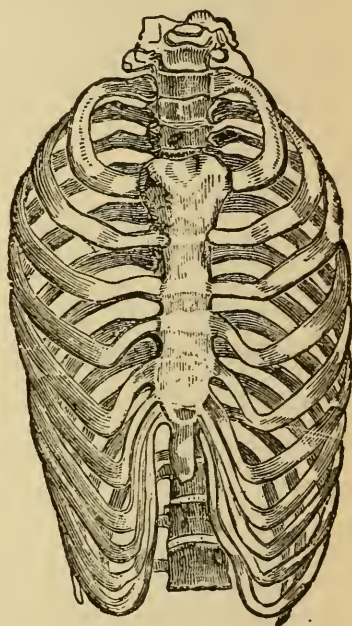


FIG. 10.—A Deformed Chest, the Result of too Tight Clothing or Tight Lacing.

misshapen chests because they have *worn waists which were too tight or laced too tightly*. The bones of the trunk form cavities for very important organs; tight lacing crowds these organs so that they cannot do their work properly, and as a result the health suffers.

51. Give the lungs every chance to expand and allow the heart to beat properly; and do not crowd the stomach and other organs in the abdomen by tight

lacing. Fig. 10 is the picture of a chest which has become deformed through tight lacing; compare it with Fig. 9, the natural chest, and notice the difference.

52. Wear Shoes of Proper Size and Shape.—

If the shoes are *too small*, *too pointed*, or *too narrow*, the feet will become deformed, the toes bent and crooked, and painful *corns and bunions* will result (Fig. 12).



FIG. 11.—A Natural Foot.



FIG. 12.—A Foot which has Become Deformed and Affected with Corns and Bunions as a Result of Tight and Ill-fitting Shoes and High Heels.

53. Avoid High Heels.—High heels crowd the foot into the front part of the shoe, thus making the toes overlap. They do not support the weight of the body properly, because they throw the upper part forward. They cause us to walk very awkwardly and thus add to the danger of injuring the ankle in falling and in other accidents.

54. Breaking a Bone.—When a bone is broken the accident is quite serious and is called a *fracture*. The doctor is called and he *sets* the bone; that is, he brings the two broken ends together. He keeps them

in proper position by fastening a piece of thin board to the limb so that the broken bone cannot be moved. When kept at rest in this manner, the two ends gradually grow together. If you happen to break a bone, remember to keep as quiet as possible until the doctor arrives, so as not to move the injured part.

55. Effects of Alcoholic Drink and of Tobacco upon the Skeleton.—Drinks containing alcohol and the use of tobacco will *prevent the bones from growing to their natural size*. Our skeleton grows until we have become men and women; and if we wish to be large and finely built, we must take care of our bones during childhood. Anything which causes the health to suffer will interfere with the growth of the bones.

56. Smoking Stunts the Growth.—Some boys smoke cigarettes because they very foolishly imagine that it makes them look big and manly. What a sad mistake! Such boys do not grow to their natural size, for *tobacco stunts the growth*. It has other evil effects upon young persons about which we will read later on. But upon the skeleton the bad effects of tobacco are very marked. The boys who smoke cigarettes are usually the smallest in the class.

57. The use of strong drinks, by which we mean those containing alcohol, has a similar effect. The bones of drunkards, if broken, do not unite as readily as do those of other persons.

QUESTIONS.

1. Why is it very important for the skeleton to have proper care during childhood? 2. What is the proper position in standing and in sitting? 3. What position should we assume at our desks? 4. Where must the book be held in reading? 5. What are the consequences of a faulty position in standing or in sitting? 6. What injury results from clothing which is too tight? 7. What are the evil effects of tight lacing? 8. What are the results of wearing shoes which are too small or too narrow? 9. Why is it injurious to wear high heels? 10. What is a fracture? 11. What does the doctor do in the case of a fracture? 12. What effect has the use of alcoholic drink upon the skeleton of the young? 13. What effect has the use of tobacco upon the growing skeleton? 14. What effect has smoking upon the growth of boys?

LESSON VI.

THE JOINTS.

58. **The Use of Joints.**—Wherever two or more bones meet, there is a *joint*. Joints are necessary in order that one part of the body may move independently of the other. If this arrangement did not exist, we would have to move the entire body whenever we wanted to move any part of it.

59. You may remember seeing boys on stilts or having used them yourself; it may be great sport, but the motion is certainly very awkward. If your limbs had no joints, you would be compelled to walk in this same awkward manner.

60. The handle of a pump is attached by means of a joint, and the swinging signs seen in front of stores furnish other familiar examples.

61. The more joints there are in any part of the body, the more movable is that part. Notice, for instance, how movable and nimble the fingers are, and how many joints there are in the hand. Some joints permit very little motion, while others allow a great deal.

62. **Why the Joints of Machinery Must be Kept Oiled.**—If two surfaces rubbing against each other were dry, they would soon be rubbed off; hence it is necessary to keep the inside of the joints *moist*.

All machines have a great many joints, and these require *oiling*. The next time you go on a journey by train, get out of the cars at one of the larger stations and watch the men go along from one car to the other, pouring large quantities of oil upon the axles of the car-wheels. Even the delicate watch, the useful clock, and the swift bicycle require oiling from time to time.

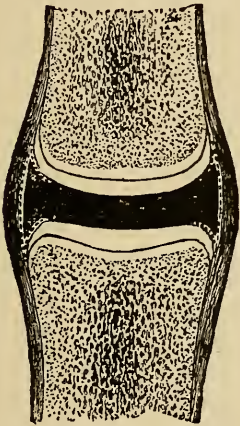


FIG. 13.—One of the Joints Sawed through Lengthwise, thus Showing the Inside of the Joint.

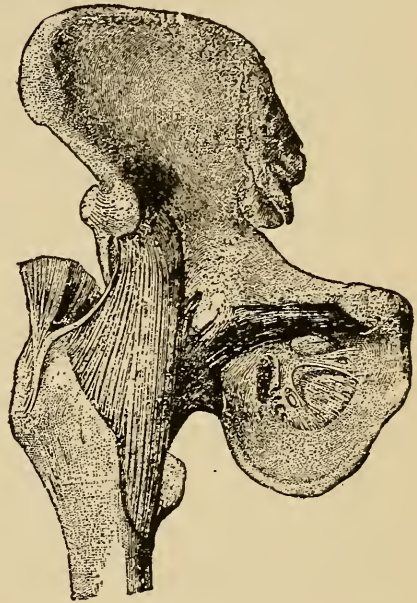


FIG. 14.—The Hip-joint, Showing the Bands of Tissue which Cover the Joint.

63. How the Joints of the Body are Kept Moist.—In the living body the joints are not oiled, but the same thing is accomplished by a *yellowish fluid in the joint*.

64. How the Bones are Kept in Place.—The ends of the bones forming a joint are held in place and connected by strong and tough *bands of tissue*, which act as a *cover* to the entire joint. In Fig. 13 we see the inside of a joint; in this space there is a

certain amount of fluid to keep the ends of the bones moist and to prevent friction. In Fig. 14 the outside of a large joint is shown, with its covering of strong, tough bands of tissue.

65. Examples of Joints in the Human Body.

—Notice how you can turn the head from side to side, open and close the mouth, and move the forearm up and down; these are all examples of motion at joints.

66. Tissues.—We have made use of the word tissue. What is a tissue? A *tissue* is one of the simple forms of material of which the different parts of the body are formed; thus, the finger consists of bone, fat, muscle, skin, nail, etc.; all these are tissues.

67. Accidents to Joints.—When one of the bones which forms the joint is not in its correct position and no longer fits on the end of the other, we say it is *out of joint* or *dislocated*. This accident is very painful. The strong bands of tissue on the outside of the joint are often torn. The bone must be put *in joint* again by the doctor.

68. Sometimes the strong bands surrounding the joint are injured or torn, while the bones still keep their correct position; this is known as a *sprain*.

69. These accidents are usually the results of falls. Many such falls take place in getting off street-cars, especially if the car has not come to a full stop, and if the person does not remember to get off facing the driver. In all mishaps of this sort we must keep the injured part as quiet as possible until aid arrives.

QUESTIONS.

1. What is a joint? 2. What advantage is there in having joints in the body? 3. What would result if there were no joints? 4. Why must the joints of machinery be kept oiled? 5. How are the joints in the body kept moist? 6. How are the ends of the bones forming joints kept in place? 7. Give some examples of joints in the human body. 8. What are tissues? 9. Give an example. 10. What accidents may happen to joints? 11. What do we mean when we say a bone is out of joint or dislocated? 12. What is a sprain? 13. How do these accidents usually take place?



FIG. 15.—The Muscles of the Human Body (the Skin having been Removed)

LESSON VII.

HOW THE DIFFERENT PARTS OF THE BODY ARE MOVED.—THE MUSCLES.

70. Now we will consider some of the tissues which cover the framework and fill up the spaces between the different parts of the skeleton. The first of these are the *muscles*.

71. What Muscles Look Like.—Muscles are the red masses which we commonly call *flesh* (Fig. 16). What the butcher sells as *meat* is a mass of muscles from some animal. When we have roast beef for dinner, we are eating a large number of muscles from the ox. Muscles are of a blood-red color. Each muscle can be separated into reddish, threadlike fibres which are joined side by side.

72. The Work of Muscles.—Muscles give us the *power of moving* the different parts of the skeleton. Our skeleton would be of very little use if we could not move the different bones. The sails of a ship would not answer their purpose unless there were ropes and pulleys to move and to fasten them. The ropes are to the sails what our muscles are to the different parts of the body.

73. The Ends of Muscles.—Muscles are very strong, but still they are too soft to be fastened directly to bone; they would not hold. At each end

muscles become changed into strong, tough cords ; by means of these they are fastened to the bones (Fig.



FIG. 16.—A Muscle.

16). Feel the thick part on the front of your arm ; you are feeling muscle. Then catch hold of your wrist and move your fingers and your hand ; you now feel the cords move quite distinctly. Some of these cords pass through the palm of the hand to be fastened to different parts of the fingers.

74. Fat.—You probably all know what fat looks like. It is of a yellowish color. Muscles always have a little fat mixed with them. When free from fat we say meat is *lean* ; but even then a little fat is present. Besides this smaller amount, there is more or less fat in layers between and covering the different muscles.

75. The Muscles on the Outside of the Body Can be Moved at Will.—Most

of the muscles of the body do not act unless we wish them to. They are therefore *under the control of the will*. They remain at rest until we desire to use them. This applies to all muscles on the *outside* of the body.

76. Muscles Inside the Body are Not Under the Control of the Will.—The muscles which are *inside* the body act *without our knowledge*. Some of them act constantly and others only at certain times ; but in either case it is not in our power to prevent such action. Let us illustrate by examples :

77. After we swallow our food it enters the stomach. Part of the wall of the stomach consists of muscle

tissue, and this is brought into action by contact with the swallowed food ; the latter is moved and rolled about so as to be ground into finer particles. This is done without our knowing anything about it, and without our being able to hinder it.

78. The *heart* furnishes another example. Day and night this organ, which is formed of muscle tissue, is at work pumping blood into the blood-vessels, to be carried all over the body. If we had to watch over the heart to see that it kept on beating, we would always have to stay awake ; and if we were careless and fell asleep, and the heart stopped because we were not directing it to keep on, life would cease at once. This shows how necessary it is for certain parts to continue at work without being directed by us.

79. **The Way in Which Muscles Act.**—When a muscle acts, it causes some part of the body *to move*. If we watch a muscle while it is acting, we will see that it becomes *shorter*, *broad*er, and *thick*er, and at the same time *hard*er. You may have seen boys feeling the muscles of their arms ; when these muscles are big and hard, they will be very proud of them.

80. Place your left hand upon the front of your right arm ; now close your right hand and bend the forearm upon the arm. You will find that the muscle on the front of the right arm becomes hard, swells up, and forms a lump. In doing this it becomes shorter, and, since it cannot break loose from its fastening to the bones, it must bring these bones nearer together ; in this way the forearm is bent upon the arm (Figs. 17 and 18).

81. **How the Brain Directs the Muscles to Act.**—The muscles on the outside of the body cannot act unless we direct them. The order to act comes from the *brain*, which is a very important organ contained in the box formed by the bones of the skull.

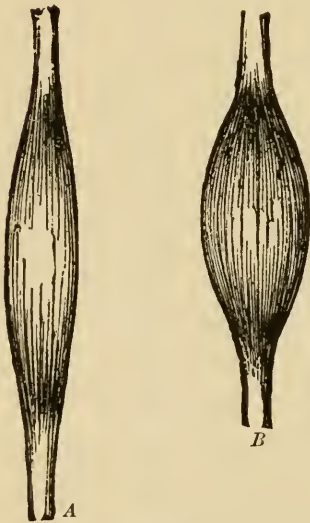


FIG. 17.—*A*, a Muscle at Rest; *B*, the same Muscle in Action. It has become shorter, broader, and thicker.

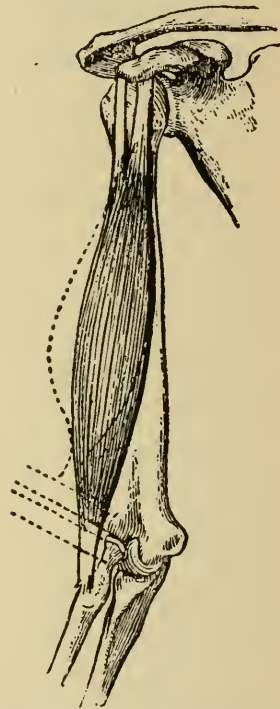


FIG. 18.—The Action of the Muscle of the Front of the Arm. (The dotted figure shows the effect upon the position of the forearm.)

If the brain wishes a certain muscle to act, it sends it a message, and then the muscle obeys. The message goes from the brain through a soft, whitish matter in the backbone, called the *spinal cord*; then it is continued by certain white threads, known as *nerves*, until it reaches the muscles. These muscles are therefore only the *servants of the brain*. Without an

order from the brain, carried by the nerves, they could not move.

82. **Muscles Vary in Size and Shape.**—There are about six hundred muscles in the human body, and nearly all of them occur *in pairs*; that is, they are the same on the right side as on the left. Some of the muscles are very *large*, others are of *moderate size*, and still others are very *small*. They also vary in shape. Most frequently they are *long* bundles with a tough and strong cord at either end for fastening to the bones. But they may be *flat*, or like a *fan*, or *square*, or *round*.

83. **The Muscles of the Face.**—All the different expressions of the face are produced by the actions of a number of small muscles which are found here. If you have a constant sullen and angry look, the face will soon have this expression, because the muscles become so accustomed to acting in this way that they cannot do otherwise.

QUESTIONS.

1. What does muscle tissue look like? 2. What is it commonly called? 3. What use do we make of muscles? 4. What can you say about the ends of muscles? 5. Why are muscles changed at their ends in this manner? 6. What is fat? 7. How does it occur with muscle? 8. What two kinds of muscles are there? 9. Can we move all muscles at will? 10. Which muscles are under the control of the will? 11. What is peculiar about muscles inside the body? 12. Give examples to show that muscles inside the body are not under the control of the will. 13. Why is it so very important that certain muscles continue to act without direction on our part? 14.

What part does the brain take in the action of muscles? 15. How do muscles change when they act? 16. Give an example. 17. How do muscles vary in size? 18. How do muscles vary in shape? 19. How are the muscles of the face connected with the different expressions?

LESSON VIII.

THE CARE OF MUSCLES.—EXERCISE.

84. The muscles form such a large part of the body that they soon show changes whenever our health is poor. During sickness they waste away and become smaller. Even after being confined to bed for a few days we are surprised how weak we feel on getting up, and how difficult it is for us to stand. During this short period our muscles have become smaller because we could not exercise them. In order to get strong muscles they must be worked or *exercised*.

85. **Strong Muscles.**—Look at the arm of a blacksmith and see how large and strong his muscles are. How they stand out in lumps and cords! This is because he is constantly using or exercising them. It is a fine sight to see a man who has large muscles which make him look strong and manly. Such a man is not so apt to get sick as another; he feels stronger and is more useful in the world because of his strength.

86. **Proper Exercise is Necessary to Good Health.**—You should all have *plenty of exercise* and this ought to be taken *regularly*. It is not enough to walk slowly to school each day; if this is all the exercise a person takes his muscles will become small and weak, and he will become delicate. Children

should have at least *two or three hours' exercise every day*. The best exercise is that which is taken in the *open air* in playing with one's companions, because it rests the mind and develops the body at the same time.

87. **Good Forms of Exercise.**—Walking fast, moderate running, rowing, swimming, skating, bicycle riding, and playing baseball, football, tennis, and croquet are all good forms of exercise.

88. **Calisthenics.**—Calisthenics are very useful. They are light gymnastic exercises which not only develop the muscles and make them strong, but also help us to become graceful in our motions.

89. **Harmful Exercise.**—Whatever the kind of exercise we must remember to stop when we begin to feel tired, for this is a sign that we have had enough and need rest. If exercise be continued too long it is harmful. Often we see girls jumping the rope—one is trying to outdo the other in the number of times she jumps without stopping; many of the girls will be so tired that they can scarcely continue, and yet they go on simply to outdo their companions. They do themselves great harm by this excessive exercise; even death has resulted from it.

90. **Avoid Violent Exercise.**—We should also *avoid all violent exercise*, for this does more harm than good. When boys try to lift heavy weights which would be a task even for men, or to do too difficult feats in the gymnasium, producing too great a strain upon the muscles, it only harms them instead of causing them to increase in strength.

91. Effects of Alcoholic Drink and Tobacco on the Muscles.—The muscles have no greater enemies than alcoholic drink and tobacco. This is so well known that all persons who prepare themselves for great feats of strength avoid the use of alcoholic drink and do not smoke. What alcohol is will be explained in another lesson. It will be sufficient to say here that all those drinks, like beer, wine, and liquor, which cause men to become intoxicated, contain alcohol and are called alcoholic drinks.

92. Athletics.—Boys, you probably all take an interest in athletic sports. It is well that you should, for these sports are very good when indulged in moderately. One of you is the fastest runner in the class, another can jump farther than any other boy, and still another can jump higher than the rest. There is probably quite a little rivalry among you as to which boy shall excel in these sports. You will always find that those boys who take plenty of exercise, who go to bed early and get plenty of sleep, eat plain food, and spend much of their time out in the open air, are the ones who can outrun and outjump the rest. *The cigarette smokers are always among the last*, because they poison the system with tobacco and injure the health in this way.

93. Alcoholic Drinks Change Muscle Tissue into Fat.—Alcoholic drinks are the enemy of muscle because they change it into fat; when a muscle contains much fat, it becomes soft and weak. Look at some of the men who drink a great deal of beer and other alcoholic drinks, and notice how weak and soft

their muscles are. They may look big, but this is due to fat and not to muscle ; and though they look large, they are not strong. If they tried to run a race with men who had good, strong, healthy muscles, they would become tired and have to give up very soon.

94. The heart is formed of muscle tissue, and some of this changes to fat in the drunkard and in those who take a great deal of alcoholic drink. Such a heart cannot beat so strongly as it should ; it becomes weak. The blood is then no longer pumped into the small canals which carry it to various parts of the body as it ought to be. You can easily imagine how much the body must suffer in consequence of this.

QUESTIONS.

1. How does the condition of our health affect the state of our muscles? 2. What happens when we do not use our muscles? 3. What effect has exercise upon our muscles? 4. How much exercise should children have every day? 5. Where is the better place to take this exercise, in the open air or in-doors? 6. What is the best kind of exercise for children? 7. Mention some of the good forms of exercise. 8. What are calisthenics? 9. What effect has exercise when it is continued too long? 10. What effect has exercise which is too violent? 11. What effect have alcoholic drinks and tobacco upon the muscles? 12. What do you mean by alcoholic drinks? 13. Which boys usually excel in athletic sports? 14. What can you say about the strength of boys who smoke cigarettes? 15. Why are alcoholic drinks injurious to muscles? 16. What effect has alcohol upon the muscle tissue of the heart?

LESSON IX.

CALISTHENICS.

95. *Calisthenics* are light gymnastic exercises, useful to both boys and girls, intended to increase the *strength* and to promote *grace* and *beauty*.

96. The exercises shown in the following figures are suitable for children, either in classes at school or singly at home. None of them will be found difficult, and none will overtax the moderate strength of a child.

97. Each exercise may be repeated from three to six times before proceeding to the next; but they are to be stopped before any actual fatigue is felt. After each exercise the child is to assume the first (Attention or Rest) position.

98. They are made more interesting when performed in class to the accompaniment of music. A slower time should be observed in exercising the head and trunk than with the limbs.

99. *Dumb-bells* for children should be of wood, light in weight, and of such a size that a child can easily grasp them.

100. The *wand* is a straight piece of wood, three-quarters of an inch to an inch thick. Its length should be such that it extends from the floor to the nose of the child who uses it.

SIMPLE BODY EXERCISES.



FIG. 19.



FIG. 20.



FIG. 21.



FIG. 22.

FIG. 19.—Attention Position. The position of rest between all the simple body exercises.

FIG. 20.—Hands closed. Upper limbs bent at elbow. Forearm brought forward at a right angle to arm.

FIG. 21.—Forearm bent upon arm so that closed hand touches front of shoulder-joint.

FIG. 22.—Forearms crossed in front of chest. Hands open.



FIG. 23.



FIG. 24.



FIG. 25.



FIG. 26.

FIG. 23.—Upper limbs extended and palms of hands brought together in front of body.

FIG. 24.—Upper limbs extended and palms of hands brought together behind body.

FIG. 25.—Upper limbs extended to the side, at right angles to the body. Hands closed.

FIG. 26.—Arms extended to the side. Forearms bent upon the arms so that finger-tips touch the top of shoulder-joints.

SIMPLE BODY EXERCISES—*Continued.*



FIG. 27.



FIG. 28.



FIG. 29.



FIG. 30.

FIG. 27.—Wrist motion. Arms extended from sides of body. The open hand is raised and dropped.

FIG. 28.—Upper limbs extended in front of body. Hands closed.

FIG. 29.—Upper limbs extended above head. Hands closed.

FIG. 30.—Upper limbs extended above head. Hands open. Swing forward to sides of body.



FIG. 31.



FIG. 32.



FIG. 33.



FIG. 34.

FIG. 31.—Upper limbs are swung from the sides of the body upward so that the palms of the hands meet above the head.

FIG. 32.—Hands supported upon the hips. Head is inclined to one side and then to the other.

FIG. 33.—Hands closed. Left upper limb is extended upward and forward and left lower limb is thrown forward, while right upper limb is extended downward and backward and right lower limb remains behind. Then reverse.

FIG. 34.—Forward bend. Body bent at hip so that the fingers touch the knees.

SIMPLE BODY EXERCISES—*Continued.*

FIG. 35.



FIG. 36.



FIG. 37.



FIG. 38.

FIG. 35.—Attention or Rest Position.

FIG. 36.—Hands resting upon hips. First one and then the other lower limb is brought forward and bent at knee.

FIG. 37.—Hands resting upon hips. First one and then the other lower limb is brought forward without being bent at knee.

FIG. 38.—Hands resting upon the hips. The leg is bent backward upon the thigh.



FIG. 39.



FIG. 40.



FIG. 41.



FIG. 42.

FIG. 39.—Tiptoe motion. Hands resting upon the hips. The entire body is raised upon the toes.

FIG. 40.—Hands resting upon the hips. Entire lower limb is raised to the side.

FIG. 41.—Hands resting upon the hips. One lower limb is thrust forward and then drawn backward, the feet remaining upon the floor. Alternate right and left.

FIG. 42.—Hands resting upon the hips. One lower limb is thrust forward and bent at the knee, the other is pushed backward. In this position the body is swung backward and forward. Alternate right and left.

DUMB-BELL EXERCISES.



FIG. 43.



FIG. 44.



FIG. 45.



FIG. 46.

FIG. 43.—Attention or Rest Position.

FIG. 44.—Dumb-bells are brought across the front of the chest.

FIG. 45.—Dumb-bells are brought together in front of body. Upper limbs extended.

FIG. 46.—Arms extended from sides of body and forearms bent upon arms so that dumb-bells touch the top of shoulder-joints.

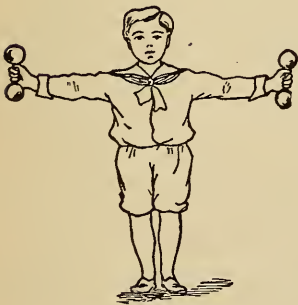


FIG. 47.



FIG. 48.



FIG. 49.



FIG. 50.

FIG. 47.—Upper limbs extended at right angles from sides of body.

FIG. 48.—Upper limbs are extended behind body and dumb-bells brought together.

FIG. 49.—Upper limbs are brought forward and extended above the head so that dumb-bells touch.

FIG. 50.—One dumb-bell is lifted upward and forward, and the other pushed downward and backward. Alternate right and left.

WAND EXERCISES.



FIG. 51.



FIG. 52.



FIG. 53.



FIG. 54.

FIG. 51.—Attention or Rest Position.

FIG. 52.—Wand held vertically in front of the right, and then the left, side of the body.

FIG. 53.—The upper hand grasping wand is raised above the head.

FIG. 54.—The wand is held in front of chest; one upper limb is extended the other is bent at the elbow.



FIG. 55.



FIG. 56.

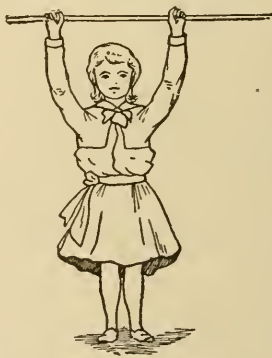


FIG. 57.



FIG. 58.

FIG. 55.—The wand is held in front of the body on a level with the upper part of thighs.

FIG. 56.—The wand is raised to the level of the neck.

FIG. 57.—The wand is raised above the head, both upper limbs being extended.

FIG. 58.—The wand is raised above the head and then lowered behind the head to the back of the shoulder.

LESSON X.

GROWTH AND REPAIR.

101. **Growth.**—We are sure most of you have noticed how the plants and trees grow, and how they increase in size from year to year. Several years ago, one particular tree which stood directly in front of the house in which you lived may have been of small size ; now it has grown to be large and strong, and its branches spread in every direction. And when you noticed this tree for the first time, you were probably a little bit of a tot ; since then you have become taller and heavier. You will say that you have grown. This is quite true. Each part of your body has become larger and stronger, and each part of you will continue to increase in size and strength until you are a full-grown man or woman.

102. **Repair.**—But you must not imagine that during all this time there were no changes taking place in your body except additions. While you were growing, your body was being constantly used up and replaced by new parts. When you have stopped growing and have become a man or woman, this process of wearing out and of repair will continue.

103. The different parts of machinery become used up and new parts must be put in the place of the old ; we say that the machine needs repairing. Nothing

which is without life can be used for any length of time without becoming worn out.

104. In the living body, the worn-out particles are replaced at once. *The process of repair keeps pace with the process of wearing out.* Hence we do not notice that the different parts of the body are being used up.

105. **Why the Different Parts of the Body Become Worn Out.**—When night comes we feel tired. Why? Because the different parts of the body are worn out and require repair. The muscles and bones have been used during the day in exercise, the lungs in breathing, and the heart in supplying the body with blood. All these parts could not work indefinitely without having new strength given to them.

106. **How the Different Parts of the Body are Repaired.**—The different parts of the body are made strong and new by means of the *blood*. In another lesson we will be told about this important fluid; how it is pumped into various parts of the body and how it carries nourishing juices to the tissues.

107. **How the Blood is Supplied with Nourishment.**—You might ask where the blood gets its supply of nourishing material. The answer is that it gets it from what we eat and drink. It becomes loaded with repairing material from our food and drink. Of course the food has to be changed very much before it can mix with the blood. At certain times of the day we are in the habit of taking our meals. Nature tells us when the blood needs more nourishment *by making us hungry and thirsty.*

QUESTIONS.

1. What evidences are there that the bodies of children are constantly growing? 2. What is meant by the process of repair in the human body? 3. What happens to objects which have no life, which are in constant use? 4. Why must the different parts of machinery be replaced or repaired from time to time? 5. Why do we fail to notice that the different parts of the living body are constantly being used up? 6. Why do the different parts of the body become worn out? 7. In what manner are the tissues repaired? 8. How is the blood supplied with nourishment? 9. What is the real meaning of our becoming hungry and thirsty? 10. Can the food be taken up directly by the blood without any change?

LESSON XI.

THE FOOD OF PLANTS AND ANIMALS.

108. **Food and Drink are Essential to Life.**

—Without food and drink we could not live; the tissues would become used up and worn out, and there would be nothing with which to repair them. We often hear of people fasting for a long time. It has happened that persons have lived for a few weeks without food, but never without drink.

109. It is easy to see why this must be so. Even when we are as quiet as possible, the different tissues of our body are constantly changing and being changed into material which is waste and must be cast off. We must breathe, and our heart must beat, and both of these are actions which require nourishment from the blood. If the blood did not get a supply of this from our food and drink, it could do no repairing. As a result, the tissues would soon waste away. The person would then die from weakness, because both blood and solid tissues would become changed so much that they would be unable to do the work which it is necessary for them to do.

110. **Difference in the Food of Plants and Animals.**—The food of plants is quite different from that of animals. You may say that you do not see plants taking any food, but it is easy to prove that

they require food and drink just as animals do, only of a different kind. Suppose you took a growing plant from the ground and locked it up in some closet in your house, where it would have neither soil nor sunshine nor water; you know very well that it would not thrive; it would wither and finally die.

111. The Food of Plants.—The food which plants require consists of *air*, the *gases* contained in the air, *moisture* from the ground, and certain *mineral salts*. These salts are in the soil and are dissolved by the moisture, which is then taken up by the roots. Besides these, *almost all plants require sunshine*.

112. The Food of Animals.—Animals need more food. These things, which we have just read are sufficient for plants, are entirely too simple for animals to exist upon. If you tried the experiment of feeding your pet dog upon nothing but water, air, and salts, you would find that he would become very thin and weak, and would soon starve to death.

113. Difference in the Food of Various Classes of Animals.—Some animals live almost entirely upon *fleshy* food; that is, meat; the cat, the dog, the lion, and the tiger are examples of flesh-eating animals.

114. Other animals exist upon *vegetables*, grass, grain, and the like; the cow, the horse, and the rabbit are examples of this class.

115. Man belongs to neither of these two classes; he combines the two; he requires *both fleshy food* (meat) *and vegetable food*, and in addition he must also have *water* and *mineral salts*.

QUESTIONS.

1. Why must we take food and drink? 2. What would happen if we took no food or drink for any length of time? 3. Why must the body die if it cannot get food and drink? 4. Describe the food upon which plants live? 5. How can you prove that plants require certain food? 6. Is sunshine necessary for the life of plants? 7. Can animals exist upon the same food as plants? 8. Can all animals exist upon the same kind of food? 9. What kind of food do the dog and cat require? 10. What are flesh-eating animals? 11. What kind of food do the cow and horse require? 12. Could man exist upon flesh alone or upon vegetables alone? 13. What kinds of food does man require?

LESSON XII.

OUR FOOD.

116. There are many kinds of food. Some food is rich in nourishment and some contains very little.

117. **Food which is Easily Digested.**—Some of the food is very simple, and we say it is *light* or *easily digested*. This means that it gives the stomach very little work in changing it into fluids which can pass into the blood and thus be carried to the different parts of the body. Examples of such food are milk, beefsteak, roast beef, soft-boiled eggs, boiled mutton, boiled rice, and bread.

118. **Food which is Difficult to Digest.**—Other kinds of food give the stomach much work and are therefore considered *difficult to digest*, *heavy*, or *indigestible*. As examples of such we might mention pork, pies, tarts, plum-pudding, and cheese.

119. **Food which we Never Tire of.**—There are some kinds of food, such as bread, milk, eggs, and roast beef, which we seem never to tire of. These are usually simple and easily digested.

120. **Milk.**—The milk which we use in this country is obtained from the *cow*; in some other countries it is also obtained from the goat and other animals. Milk is one of the best articles of food and is very easily

digested. It contains everything in the nature of nourishment which we need; hence *we could live on it* without any other food. Children should take milk with every meal.

121. **Butter.**—The fatty part of the milk, the *cream*, floats on top after the milk has been standing for a time. When milk is churned the fat-globules, of which the cream consists (Fig. 59), stick together. In this way a mass is formed; this is called *butter*.

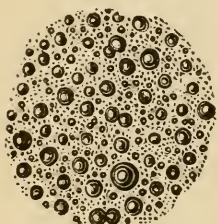


FIG. 59.—A Drop of Milk Seen under the Microscope, Showing the Fat-globules (Cream).

122. **Eggs.**—Eggs are obtained from the hen. They are very useful as food. Part of the contents of the egg consists of a yellow, fatty substance, called the *yolk*; the rest forms the *white* of the egg.

123. **Bread.**—Bread is a very important article of food, on which account it is often called the *staff of life*. It is made from *flour*. In America, this is usually wheat ground up fine. The baker takes flour and adds water and a little salt, and with these he makes the *dough*. He also adds *yeast*, and will tell you that he does this to make it rise, so that it will be light and easy to digest. What does the yeast do? It changes some of the starch so that a gas is given off. This gas escapes in bubbles, but cannot get through the dough; in trying to work its way out, it puffs out the dough and makes it light and porous. The dough is then put in the oven and baked, a hard crust forming on the outside.

124. **Starch.**—The greater part of bread consists of *starch*. Starch is found only in vegetable food—that

is, food produced by plants. Examples of vegetable food containing starch are wheat, corn, rye, barley, rice, oats, and potatoes. Grass and hay also belong to this class.

125. Man could not eat hay, since his stomach is not arranged so that he could digest it; but the ox eats hay, which is converted in his body into nutritious materials from which his flesh is formed, and the latter is then eaten by man.

126. Starchy food cannot be digested in the raw condition; it must first be *boiled* before it can be used as food. Man would not think of taking oatmeal raw, but only after it had been boiled; then it forms a very useful food. A *bowl of oatmeal* should form part of your breakfast every morning.

127. **Sugar.**—Another form of vegetable food has a large quantity of *sugar* in it. Besides this, we add some of this substance to sweeten certain kinds of food. Sugar is nourishing and does no harm if not taken in too great an amount.

128. **Green Vegetables.**—It is necessary for good health that we eat *green vegetables*, as peas, spinach, string-beans, salad, and the like. When deprived of these for any length of time the blood becomes poor and the body suffers.

129. **Fat and Fatty Food.**—We need a certain amount of *fat* or *fatty food*. This explains our putting butter upon bread. In the body, starchy and sugary food is changed into fat, and this is why we say that potatoes, bread, and the like are fattening.

130. **Fruit.**—The various *fruits* are useful as food.

They contain but little nourishment, but serve to increase the appetite and to help the stomach in its work. Care must be taken in selecting fruit, so that it is neither unripe nor overripe.

131. **Fleshy Food.**—By fleshy food is meant *meat*, whether from the ox, sheep, or other animals of this class, or from fishes.

132. **Meat and Fish.**—There are a great many different kinds of meat. *Beef* is used more than any of the others. Besides beef from the ox we use *lamb*, *mutton* from the sheep, *veal* from the calf, *pork* and *ham* from the pig, and *venison* from the deer. Under this head also come *chicken*, *turkey*, and other fowl; also the various birds. *Fish* is a very useful form of fleshy food, and is usually quite easily digested.

133. **Salt.**—It is necessary for us to take a certain amount of *salt* with our meals. Most of our food contains some; but in addition we are in the habit of adding salt, either in cooking or when the food reaches the table; when this is forgotten, our food tastes flat.

134. **Methods of Cooking.**—Sometimes we eat our food *raw*; as, for instance, fruit. But usually we *cook* it, because it becomes more digestible and tastes better. In cooking we may make use of a great many different plans. If it is meat, for instance, we may put it into water and *boil* it; or if we let it get a little thicker, we *stew* it. We may put it into the pan with some fat and *fry* it; this is not a good way of preparing meat because it covers it with a fatty layer which is very difficult to digest. By holding it directly to

the fire we *broil* it or *roast* it. Finally, by putting it into the oven, we *bake* it. Of all these different methods, *boiling*, *stewing*, and *broiling*, are most to be recommended, because they make the food most easy to digest.

QUESTIONS.

1. What do you mean by food that is easily digested?
2. Give a number of examples of such food.
3. What do we mean by food which is difficult to digest?
4. Give a number of examples of such food.
5. Give a number of examples of food which we seem never to tire of.
6. From which animal is milk usually obtained?
7. Why is milk one of the best articles of food?
8. Could we exist on milk alone?
9. What part of the milk does the cream represent?
10. What is butter?
11. What can you say about eggs as food?
12. Of what two portions does an egg consist?
13. What is bread often called on account of its importance?
14. How is bread made?
15. Why is yeast added?
16. How does the yeast make the bread light and porous?
17. Of what does the greater part of bread consist?
18. In what kind of food is starch found?
19. Give a number of examples of vegetable food containing starch.
20. How must starchy food be prepared before it can be digested by man?
21. What can you say regarding the value of oatmeal as an article of food?
22. In what way is sugar taken into the body?
23. Why are green vegetables necessary to health?
24. Give a number of examples of green vegetables.
25. Why do we put butter upon our bread?
26. Why is food containing starch and sugar said to be fattening?
27. What are the uses of fruit?
28. What is meant by fleshy food?
29. Mention a number of the different kinds of meat.
30. What can you say of fish as an article of food?
31. What can you say regarding the necessity for salt?
32. Mention some of the different methods of cooking.
33. Why do we usually cook our food?
34. What are the best methods of cooking meat?
35. What objection is there to frying?

LESSON XIII.

THE WATER WHICH WE DRINK.

135. **Water is Necessary to Life.**—Water is even more necessary to life than is food. A person could live longer without food than without drink. The great drink and the only one necessary for life is water—*pure water*. Three-fourths of the weight of the body is water; if you weigh eighty pounds, sixty pounds are water. From this it will be easy to understand why water is so essential to life.

136. Much of our food contains water, for we do not take any in a perfectly dry form. Soup and milk contain a great deal of water, and a large amount exists in meat and vegetables.

137. But besides water in this form, we drink considerable with our meals, and again whenever we feel thirsty.

138. **Thirst.**—Feeling thirsty means that the body requires water. It is *Nature's signal for water*, just as hunger is the signal for food. As a rule, we should drink enough water to satisfy this thirst. Water should be swallowed slowly—a mouthful at a time, and not gulped down. It is of especial importance to remember this during meals.

139. **Pure, Cool Water.**—There is no drink which

is so refreshing as *pure, cool water*. If the drinking-water be warm, it is best cooled by filling bottles and laying these upon the ice. If we drink iced water, no harm will usually be done if it is taken slowly. When the body is heated great harm, and even danger may result from drinking a gobletful of iced water very rapidly.

140. Tea, Coffee, Chocolate, and Cocoa.—Much of the liquid which we drink we take in the form of *tea, coffee, chocolate, and cocoa*. Grown people, while not usually harmed by tea and coffee, sometimes make themselves nervous by drinking too much or in too strong a form. Both tea and coffee are injurious to children, for whom milk and water are the best drinks. Cocoa and chocolate contain considerable nutritious fatty matter and are therefore more of a food; tea and coffee are only *stimulants*—that is, they excite the body for the time. Children do not need stimulants of any kind.

141. Our Drinking-water.—Water is the great drink, and it is very necessary that it be *pure*. Clear water is not always pure; water may be very impure and still be very clear and transparent. And again, water may look a little cloudy, and yet be perfectly innocent and healthy. What makes some water unhealthy and injurious is *poison dissolved from the soil*. In cities, where the water is brought from a distance in pipes, this poison is not apt to occur; but where the water from wells is used, it is often present. In the country, very often no other water can be obtained except that from the well; for convenience

sake, the well is built near the house and the stable ; it is then very apt to be poisoned.

142. **How Well-water may Become Poisoned.**

—Fig. 60 illustrates very nicely the manner in which well-water may become poisoned. It is a good example of what occurs constantly in the country. An examination of this picture shows the following: To

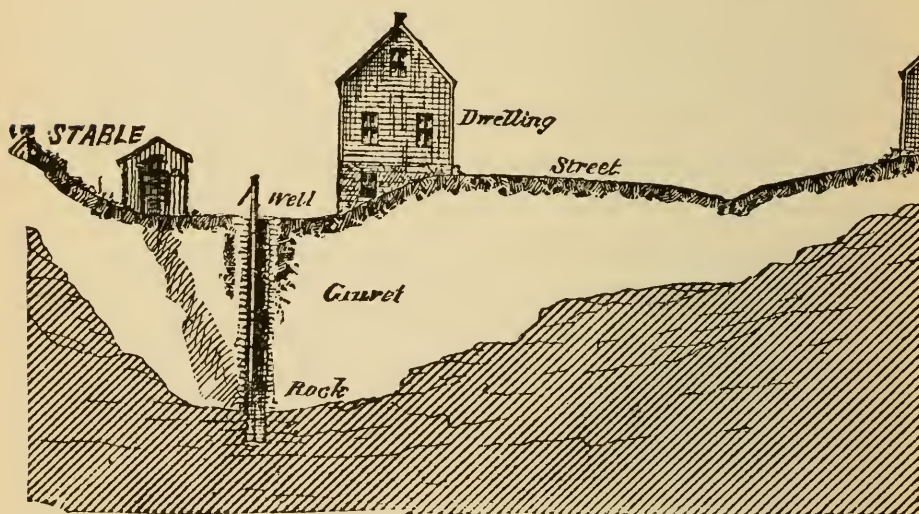


FIG. 60.—The House and the Well, as often Found in the Country. The shading extending from the stable to the layer of rock at the bottom of the well shows the course of the poisonous material from the stable, with its manure-heap and pig-pen, to the well.

the right is the dwelling-house ; to the left is the stable with its manure-heap and pig-pen ; between these two is the well. The surface of the ground is fairly level, and is sandy, and beneath this is gravel. The rain soaks into the porous ground, and in doing so dissolves poisonous matters from the manure-heap and the pig-pen, and after it has soaked into the ground it remains there, since there is a layer of rock

below, which will not allow the water to pass. This poisoned water collects here, and then gradually enters the lower part of the well. When water is drawn from the well it will be easily understood that it is partly the same water which has passed over and through the manure-heap and the dirt of the pig-pen before passing into the ground. The shading extending, on the figure, from the stable to the bottom of the well, shows the course which this poisoned water takes. Such water causes typhoid fever and other diseases.

143. How to Avoid Poisoning of Our Drinking-water.—The water of a *pure river* should be preferred to that of a well. But sometimes we have no choice and must drink well-water. In this case we should see that the well is thirty feet or more from any inhabited building, and that no refuse or slops of any kind are allowed to soak into the ground. Such refuse should be kept in water-tight barrels and carted off regularly. If we are in doubt about whether the water is good or not, we may *boil it* thoroughly ; this destroys the poison. In addition to boiling, it is well to let drinking-water pass through a *filter*, which takes out many impurities.

144. Poisoning from Leaden Pipes.—Water which has stood in leaden pipes all night dissolves a little of the lead ; hence when we require water in the morning we should allow it to run a few minutes before using any.

QUESTIONS.

1. What is the great drink and the only one necessary for life?
2. How much water is there in the human body?
3. Do we take any of our food absolutely dry?
4. Mention examples of food containing a large proportion of water.
5. What is the meaning of the feeling of thirst?
6. How should we drink water?
7. What is the best manner of cooling drinking-water?
8. What precaution must we take in drinking iced water?
9. What can you say of tea and coffee as drinks for grown persons?
10. What can you say of tea and coffee as drinks for children?
11. How do cocoa and chocolate differ from tea and coffee?
12. What is a stimulant?
13. Do children need stimulants?
14. Is clear water always pure?
15. Is cloudy water always injurious?
16. What makes some drinking-water unhealthy and injurious?
17. Why does poisoned water occur less frequently in the city than in the country?
18. How may well-water become poisoned?
19. How can we avoid poisoning in our drinking-water?
20. How can drinking-water be made safe, if we are in doubt as to whether it is good or not?
21. How may water become poisoned from leaden pipes?
22. How can we avoid danger from this source?

LESSON XIV.

HOW THE FOOD IS CHANGED IN THE STOMACH.

145. **The Work of the Organs in the Abdomen is to Digest the Food.**—The food must be changed into a *liquid* before it can mix with the blood. This is done by the organs in the abdomen and is called *digestion*. Hence the work of the stomach and other organs of the abdomen is *to digest the food*. While being changed in this way, the food passes through a number of *hollow organs* (Fig. 61).

146. After being chewed and swallowed, the food passes down a tube in the neck, called the *gullet*, to reach the *stomach*. A considerable part of the food is changed here and proceeds farther, together with the portion which the stomach has refused to digest. These different portions of the food next reach the *bowels* or *intestines*. All these different parts are seen in Fig. 61. We will now commence with the mouth, and follow the food through its changes in one part after the other.

147. **The Mouth.**—This is the space between the two jaws. The food is chewed here and is mixed with a fluid called the *saliva*. Some animals, like dogs and cats, swallow the food whole; but man is expected to chew it fine. For this purpose the teeth are provided.

148. **The Teeth.**—The teeth are supported by the jaws and occur in two rows, an upper and a lower (Fig. 62).

149. **The Teeth of Children.**—All the teeth of young children fall out ; they are only temporary, and

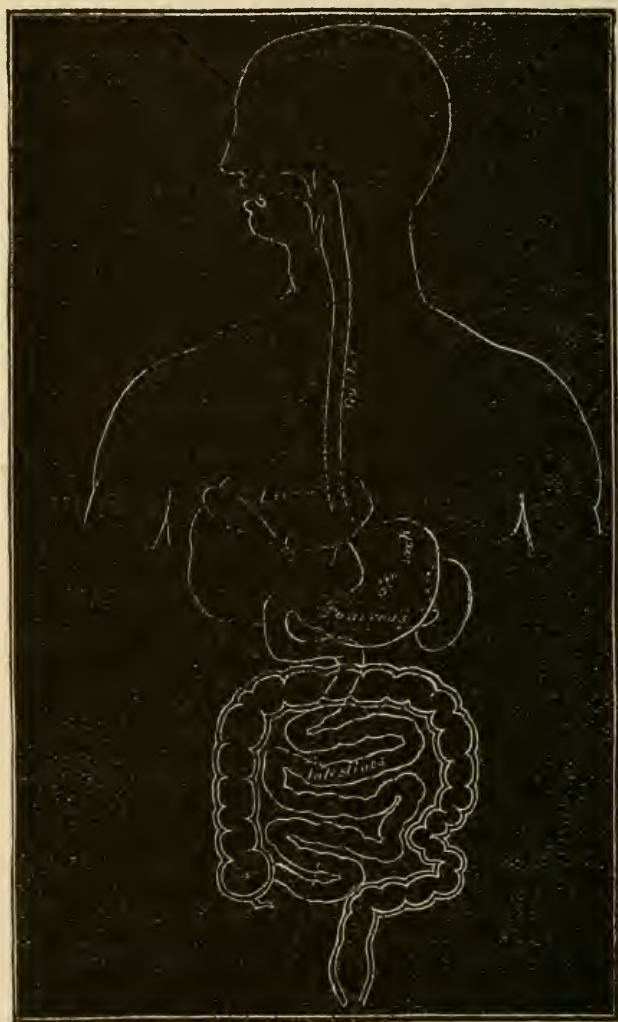


FIG. 61.—The Organs in the Abdomen in which the Food is Prepared for the Blood.

hence are called *temporary* or *milk teeth*. There are *ten* of these in each jaw, making twenty altogether.

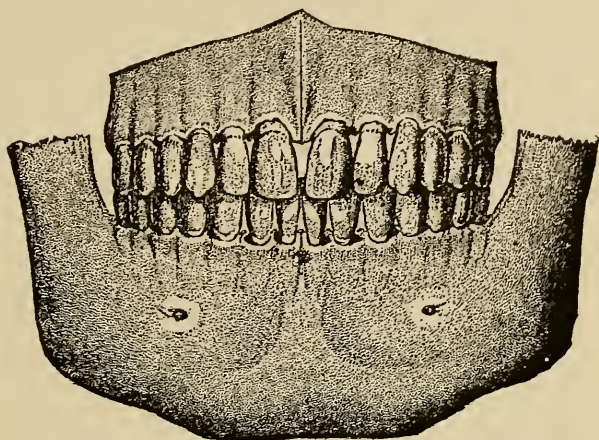


FIG. 62.—The Upper and Lower Jaws, with the Teeth, of a Grown Person.

150. **The Teeth of Grown Persons.**—In the sixth year, or before, the temporary teeth begin to fall out; and after the sixth year others grow to take their places. These are stronger and there are more of them. They are called the *permanent teeth*; and there are *sixteen* in each jaw, making thirty-two altogether.

151. **The Parts of a Tooth.**—The part of the tooth which you see in the mouth is called the *crown*; the part which is buried in the gums is called the *root* or *roots*. Teeth are composed of a very hard, white material which contains a great deal of *lime*. Those in front have very sharp edges for cutting the food and biting it into pieces. Those placed behind are



FIG. 63.—A Tooth Sawed through Lengthwise, Showing the Crown and the Roots.

broader and very strong, and serve to grind the food into small particles.

152. Care of the Teeth.—Teeth are natural ornaments when nice and healthy ; they are very disfiguring when dirty or decayed. They should be *brushed* every morning upon rising, and every night before retiring ; they should be *kept clean at all times*. Particles of food which lodge between the teeth should be removed with *toothpicks of wood or quill*—never with pins, needles, or metallic points. Teeth are apt

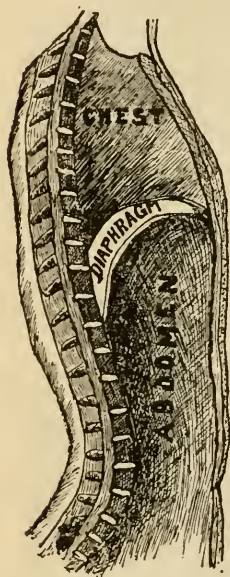


FIG. 64.—The Cavities of the Trunk of the Body. Above is the cavity of the chest. Below is the cavity of the abdomen. The diaphragm is seen separating the two.

to decay and cavities form, if the general health becomes poor, also if much improper food be taken ; by improper food is meant a great many pickles, much candy and cake, and food which is difficult to digest or too sour. Teeth should not be used to crack nuts with, nor for anything but chewing. When cavities have formed in the teeth, the dentist fills them with gold or silver foil so as to prevent them from decaying more.

153. Smoking, or the vulgar habit of chewing tobacco, discolours the teeth and makes the breath offensive.

154. The Cavities of the Trunk of the Body.—You may remember that in a previous Lesson it was stated that the trunk of the body contains two large cavities or

spaces (Fig. 64): An upper one, the *chest*, in which the heart and lungs are placed, and a lower one, the *abdomen*, in which the organs of digestion are placed.

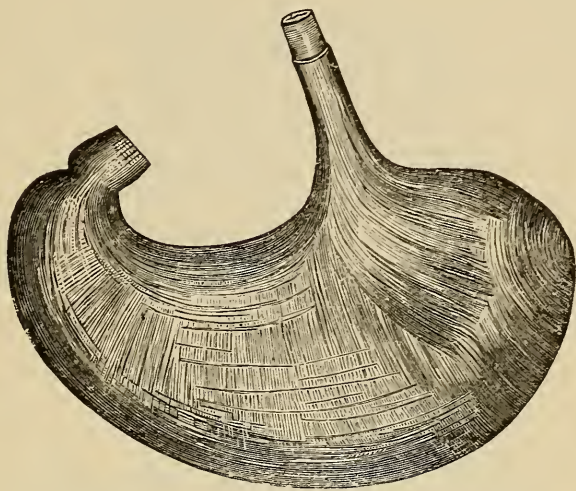


FIG. 65.—The Stomach, Showing the Outer Surface.

These two spaces are separated by a layer of muscle tissue, called the *diaphragm*—a long word which means a *partition*. Just below the diaphragm is the stomach.

155. **The Stomach.**—The stomach (Fig. 65) is a bag about a foot in length, and has an opening at either end: one for the entrance of food from the gullet, the other to allow the food to pass on after the stomach has done its work; this second opening leads into the bowels or intestines.

156. The outside of the stomach is smooth and shining so that it can glide easily over the other organs (Fig. 65). The inside of the stomach is soft, like velvet, and arranged in folds (Fig. 66). There is

a good deal of muscle tissue in the walls of the stomach which gives it the power to move the food about and to grind it fine.

157. **The Juice of the Stomach.**—Whenever food reaches the stomach, drops of fluid escape from its soft lining; this fluid is called the *gastric juice*, which means the juice of the stomach. It is formed by thousands of *little tubes* which we find in the walls of the stomach (Fig. 67).

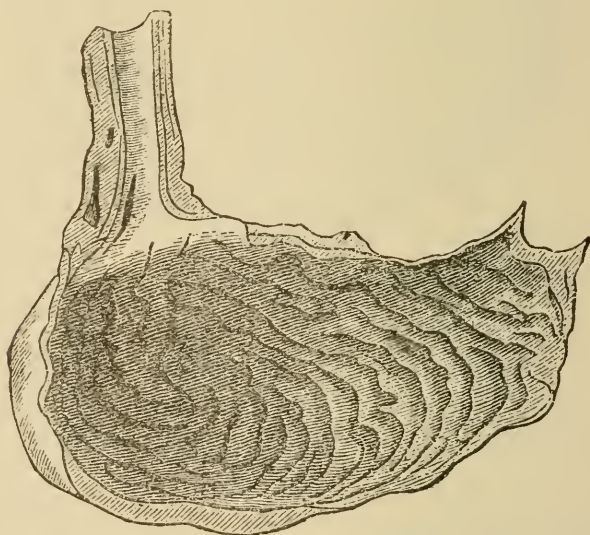


FIG. 66.—The Inner Surface of the Stomach.

158. **The Work of the Stomach.**—The work of the stomach is *to digest the food* and *to grind it fine*. It does not digest all the food, but only the *fleshy* part of the food—the *meat*. The rest of the food, the starchy and fatty portions, are changed farther on in the intestines.

159. **Effects of Tobacco on the Stomach.**—When a person smokes tobacco for the first time it

makes him sick at his stomach. He may get used to the tobacco after awhile; but still, if he smokes too much, he has the same disagreeable feeling. Many

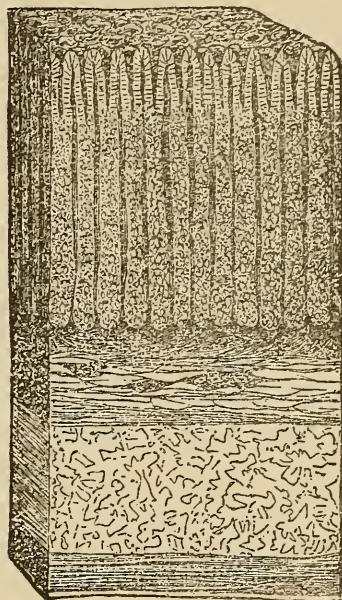


FIG. 67.—The Little Tubes of the Stomach in which the Gastric Juice is Made. Seen with the microscope.

persons make the stomach weak and delicate, and spoil the appetite, by smoking and chewing tobacco.

160. **Effects of Alcoholic Drink on the Stomach.**—Alcoholic drink reddens the lining of the stomach and irritates it. After awhile it hardens it, thins it, and renders it unfit to digest the food properly.

QUESTIONS.

1. What is the work of the organs in the abdomen? 2. Where is the gullet? 3. Into what other organ does it serve to carry the food? 4. Into what organ is the food carried after the stomach has finished its work? 5. What is the saliva? 6. Of what use are the

teeth? 7. How many rows of teeth are there? 8. How many teeth are there in children? 9. How many teeth are there in full-grown persons? 10. Why are the teeth of children called temporary teeth? 11. What is the crown of a tooth? 12. What is the root of a tooth? 13. Of what are teeth composed? 14. What is the difference in the shape and in the uses of the teeth in the front of the mouth and those in the back of the mouth? 15. How should the teeth be taken care of? 16. What happens if we neglect the teeth? 17. What will cause the teeth to decay? 18. What effect have smoking and chewing tobacco upon the teeth? 19. What cavities are there in the trunk of the body? 20. What separates the cavity of the chest from that of the abdomen? 21. What is the shape of the stomach? 22. What openings has the stomach? 23. Why is the outside of the stomach smooth? 24. What appearance has the inside of the stomach? 25. Of what use is the muscle tissue in the walls of the stomach? 26. What is meant by the gastric juice? 27. How is the gastric juice formed? 28. What is the work of the stomach? 29. What effects has tobacco upon the stomach? 30. What effects has alcoholic drink upon the stomach?

LESSON XV.

THE FINAL CHANGES IN THE FOOD SO THAT IT CAN MIX WITH THE BLOOD.—THE INTESTINES AND LIVER.

161. **The Bowels or Intestines.**—The bowels or intestines consist of a long, hollow tube, about twenty-five feet in length, commencing at the stomach. In order that this long tube may find room in the abdomen, it is folded many times around a stem which is attached to the backbone.

162. The intestines have the same coats as the stomach. They are smooth and shining on the outside, soft and velvety on the inside, and between these two coats there is muscle tissue.

163. **Motion of the Intestines.**

—The intestines are in *constant motion* in a slow and creeping manner, just like a worm. This is for the purpose of causing the food to move on. There are a great many *ridges* which run across the lining of the intestines (Fig. 68); these prevent the food from passing along too rapidly; in this way it will have plenty of time to mix with the blood.

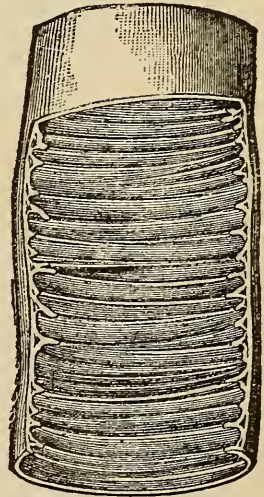


FIG. 68.—The Inner Surface of the Intestines, Showing the Ridges.

164. **The Work of the Intestines.**—The portion of the food which the stomach has changed, and the remnants which the stomach refuses to digest, pass into the intestines. Here the *starchy and fatty food is digested*. In the walls of the intestines there are a great many minute vessels in which the blood flows. What we have eaten is finally converted into a *soft, creamy liquid*, which enters these small tubes, and,

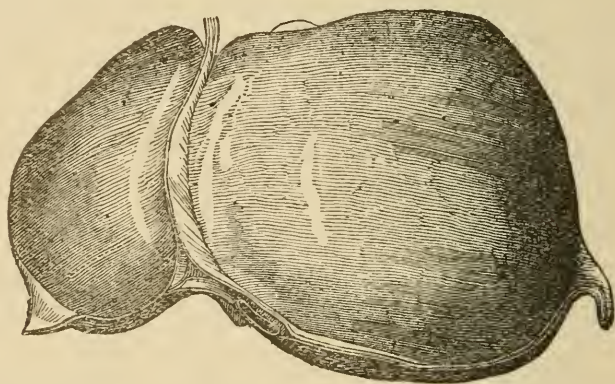


FIG. 69.—The Liver.

mixing with the blood, is carried to different parts of the body to serve as nourishment.

165. **Openings in the Intestines.**—At the upper part of the intestines, just below the stomach, we find two openings. One of these comes from the *liver*, and the other from the *pancreas*.

166. **The Liver.**—The liver (Figs. 61 and 69) is a large and important organ. It is placed on the right side of the upper part of the abdomen. It is smooth on the outside. If we cut into it, we find that it is formed of small *cells*, like cubes, packed one against

the other (Fig. 70). These cells are so small, that we must use a microscope in order to see their form.

167. The Microscope.—This instrument is constantly used in studying the finer structure of different parts of the body. Probably every one knows what a *magnifying-glass* is, and has seen it used for making objects look larger. Perhaps, too, many of you have brought the rays of the sun together into a small spot on your

hand and found how

this burns. On this account the magnifying-glass has been called a burning-glass. Such a magnifying-glass makes objects appear five or six times as large as they really are. If several very strong magnifying-glasses are placed one over the other in a metal tube (Fig. 71), objects looked at through all of them will appear a hundred, or even a thousand, times larger than they really are. This arrangement is called a *microscope*.

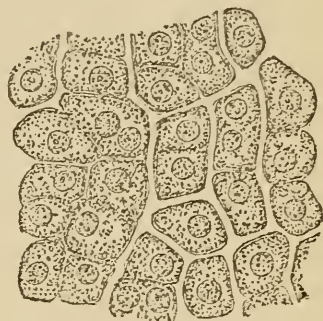


FIG. 70.—The Cells of which the Liver is Formed, as seen with the Microscope.

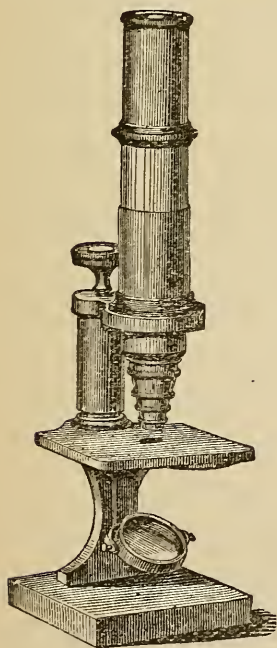


FIG. 71.—The Microscope.

168. The Bile.—The cells of the liver prepare a greenish or brownish fluid called the *bile*. This fluid passes into the intestines, from the liver, and mixes with the food.

Although we are not certain what the bile does to the food, we do know that it is an important and necessary fluid.

169. **The Liver Purifies the Blood.**—Besides furnishing the bile, the liver also *purifies the blood*. A great deal of blood passes through the liver and is purified in this way.

170. **The Pancreas.**—The pancreas (Fig. 61) is not a very large organ, but it is very important. It prepares a fluid which assists in the digestion of the food after it has passed into the intestines. The pancreas of the calf is sold by the butcher as sweetbread.

171. **The Unhealthy Liver.**—Many sicknesses are caused by changes in the liver. If we *eat too much* at a time, or eat *food which is too rich*, as many wealthy people do, the liver becomes diseased and does not remove the impurities of the blood as it should ; and these then remain in the blood and give much trouble. Perhaps some of you have seen old gentlemen limp along with the aid of a cane, unable to walk well because their big toes are swollen and sore ; they then have *gout* from *too rich food, too much wine, and too little exercise*.

172. **The Drunkard's Liver.**—The liver suffers very much as the result of *alcoholic drink*. It sometimes grows too large, and sometimes gets too small. The blood cannot flow through it as it should ; and so the liver cannot do its work properly. Thus the entire body suffers, and the most serious symptoms trouble the unfortunate man who leads the life of a drunkard.

QUESTIONS.

1. What is another name for the bowels? 2. How long are the intestines? 3. To what are the intestines attached and how? 4. What appearance have they on the outside and what on the inside? 5. What can you say of the motion of the intestines? 6. What is the object of this motion? 7. What prevents the food from passing along too rapidly? 8. Why is it necessary that the food pass along slowly? 9. What is the work of the intestines? 10. What kinds of food are changed in the intestines? 11. Into what are our meals finally converted in the intestines? 12. How does this mix with the blood? 13. What openings are there into the intestines? 14. Where is the liver? 15. Of what is it formed? 16. What is a microscope? 17. What are the uses of a microscope? 18. What is the bile? 19. Where is the bile formed? 20. What do we know concerning the uses of the bile? 21. What other work does the liver accomplish besides furnishing the bile? 22. What is the work of the pancreas? 23. What is the pancreas of the calf known as? 24. What causes an unhealthy liver? 25. How does the liver suffer as the result of large quantities of alcoholic drink?

LESSON XVI.

HOW TO ENJOY GOOD DIGESTION.

173. Take Food at Regular Times in the Day.
—Usually three meals a day are enough.

174. Do Not Eat Rapidly.—When the food is eaten too rapidly it cannot be chewed properly, and the result is that it is swallowed in large pieces. The stomach has great difficulty in digesting these large pieces and thus poor digestion results if the practice be continued. This is what the doctor calls *dyspepsia*.

175. Do Not Eat Too Much at a Time.—This gives the organs of digestion too much work to do, and on this account all the food cannot be digested. We should not continue to eat until we feel heavy and uncomfortable.

176. Do Not Eat Improper Food nor Too Many Sweets and Sours.—While a pickle occasionally at meals, or candy or cake now and then, will do no harm, if these things are taken constantly they are injurious, because they destroy the appetite for nourishing food. Girls who eat too much candy, or too many pickles, usually have very little appetite for any proper food, and soon become pale and delicate. And boys who eat green apples before they are ripe, in summer, or unripe fruit of any kind, are sure

to repent it; they are apt to become sick and to have great pain in the stomach.

177. **Do Not Chew Gum.**—This wastes the saliva and makes it so thin that it does not act as it should. Besides the habit is a vulgar one.

178. **Do Not Drink a Large Amount of Ice-water.**—A little iced water, taken slowly, will do no harm, whether during meals or at other times; but to drink down a gobletful rapidly when the body is heated is very harmful, as it chills the stomach and interferes with digestion.

179. **Avoid Violent Exercise Immediately After a Meal.**—This should not be indulged in, for at that time the stomach needs all the blood it can get. Violent exercise drives too great a proportion to the muscles.

180. **Do Not Study Directly After a Meal.**

181. **Do Not Bathe within Two Hours After an Ordinary Meal.**

182. **Avoid Excitement Just Before a Meal.**—Excitement of any kind, whether good news or bad news, usually takes away our appetite. If we eat, nevertheless, the food will not be digested, or only very imperfectly.

183. **Alcoholic Drink** makes the food less digestible, especially if it be strong drink; it also irritates the stomach needlessly.

184. **Smoking** will destroy the appetite and interfere with digestion with many persons.

QUESTIONS.

1. How many meals a day are usually enough? 2. Why should we not eat rapidly? 3. What is dyspepsia? 4. Why should we not eat too much at a time? 5. What harm does improper food cause? 6. What frequently happens to children who eat much candy or many pickles? 7. What is the effect of eating unripe fruit? 8. What objections are there to chewing gum? 9. What precaution should be taken in drinking ice-water? 10. Why is violent exercise immediately after a meal injurious? 11. Is it well to study directly after a meal? 12. How long should we wait before bathing after a meal? 13. Why is excitement just before a meal harmful? 14. What effect has alcoholic drink upon the food? 15. How are the appetite and digestion of many persons affected by smoking?

LESSON XVII.

LIFE'S FLUID.—THE BLOOD.

185. If you cut your finger, a red fluid escapes, which you call *blood*. If the cut be a slight one, only a little blood will be lost, and the accident will not worry you much ; but if it be deeper, you may have trouble in stopping the bleeding, and you would feel alarmed, for everyone knows how important the blood is. It is called *life's fluid*, and it deserves the name ; for if one-quarter of the blood is lost, life would be in danger ; and if one-third were lost, certain death would result.

186. **Appearance of Blood.**—Blood is a thin fluid of a red color. Sometimes it is *bright red*, at other times it is of a *dark red* color. Why this difference exists will be explained later. Although it has this red color, the fluid part of the blood is not red, but yellowish. It looks red because there are a great many small red bodies floating in it. These we call the *blood-globules*.

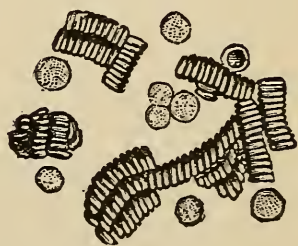


FIG. 72.—The Blood-globules.

187. **The Blood-globules.**—If we take a drop of blood and look at it under the microscope, we can easily see these blood-globules (Fig. 72). Even in a small drop

of blood, there are about ten millions of them, which will give an idea of the great number there must be in the entire body. Most of these small bodies are of a reddish color and flattened. But there are a few which are white and perfectly round. We call both the red and the white ones globules because of their shape, the word globule meaning a little sphere.

188. **Uses of the Blood.**—We have already been told that the blood *carries nourishing material* to different parts of the body. In exchange for this *it receives waste material*, which it takes to certain organs—the lungs, skin, and kidneys, which get rid of it. But the blood has another very important use, to explain which it will be necessary to say something about the air we breathe.

189. **The Air.**—The air is made up principally of two gases: one-fifth is a rich gas called *oxygen*. It is the gas which is necessary for life. The rest is a gas called *nitrogen*, which serves to dilute the oxygen so that it may not be too rich, but just right for breathing.

190. **The Pure, Bright Red Blood.**—When we take air into our lungs, it stays there a short time and gives up some of the oxygen to the impure blood. In the lungs there are a great many small blood-vessels. The oxygen passes through the thin walls of these, and the blood flowing along takes it up. This *serves to purify the blood*, and changes it to a *bright red color*. After the blood has taken up this valuable gas, it carries it to different parts of the body and gives

it to the tissues which have become used up, so that they become built up again.

191. The Impure, Dark Red Blood.—When the different tissues of the body are being used up, they give off a poisonous gas which is called *carbonic acid gas*. The blood which contains this gas is *impure* and of a *dark red color*. Such blood is purified in the lungs. Here the gas passes through the walls of the blood-vessels and escapes into the air. This is the reason why the air which we breathe out is not so pure as that which we breathe in.

192. Clotting of the Blood.—While the blood is in the body, and in the vessels through which it usually moves, it is fluid. But if taken from the body, and placed in the air, it very soon becomes thicker and thicker, and finally is a soft solid, about as thick as jelly, called a *clot*.

193. The Clotting of Blood is Very Important.—This thickening or clotting of blood is of the greatest importance. If it were not for this we would have to bleed to death every time we cut ourselves. For when we inflict a wound the blood flows until a crust forms. This *crust* is a *clot*; *it stops the bleeding*.

194. Bleeding.—If we hurt ourselves in any way and the bleeding is slight, it will usually stop of itself or after we apply a little court-plaster. Bleeding from the nose occurs frequently; it is usually harmless and stops of its own accord; if troublesome, it may be checked by pressing the finger against the side of the nose for a few minutes. But suppose we

receive a deep cut and the blood flows freely and we cannot stop it, what shall we do until the doctor arrives? We should press upon the injured part *just above the cut*, or tie a string around it instead of pressing with the finger. For instance, if it is the tip of the finger which is bleeding very much, we can tie a string around the finger an inch or so above the cut,

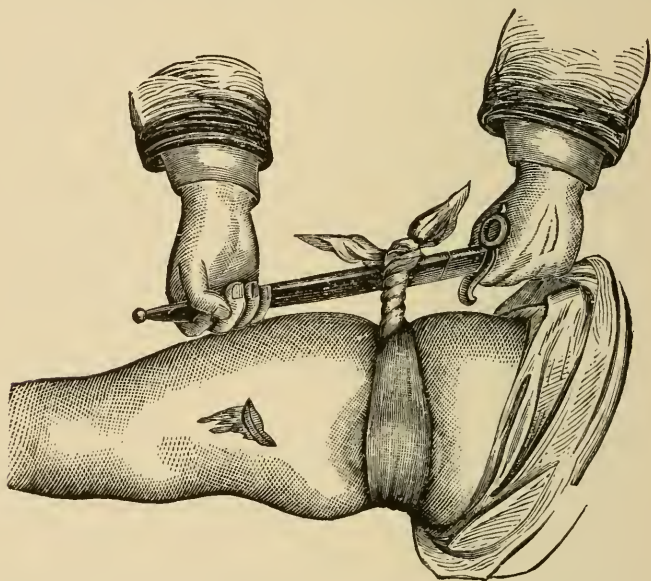


FIG. 73.—Method of Checking Bleeding from a Large Wound.

and this will stop the bleeding. If it is a larger part, as the arm or the forearm, tie a handkerchief around the limb *above* the injury and tighten this by means of a stick put under the handkerchief, and twist until it is very tight (Fig. 73).

195. **Fainting.**—When a person becomes pale and would fall if he did not hold on to something, we say he has *fainted*. The proper thing to do for such a person is to lay him down perfectly flat. There

should be no pillow underneath the head. If possible, the head should be even lower than the rest of the body so that the blood may run into the head and fill the blood-vessels of the brain; for the usual reason for the fainting is that the heart becomes weak and has not sufficient force to send enough blood to the brain. It is also important that no crowd should gather around the person, so that he can get all the air possible. The limbs should be stroked or rubbed toward the trunk, so as to help along the flow of blood.

QUESTIONS.

1. What other name is sometimes given to the blood on account of its importance? 2. What happens if the body loses a large amount of blood? 3. What does blood look like? 4. Why does blood appear red? 5. What are the blood-globules? 6. Are they very abundant? 7. What is the appearance of the blood-globules under the microscope? 8. What are the uses of the blood? 9. What does the blood do with the nourishing material? 10. What does the blood do with the waste material? 11. Of what gases is the air made up principally? 12. Which is the more useful gas? 13. What happens to the air when we take it into our lungs? 14. How does the oxygen get into the blood-vessels? 15. What does the blood do with this oxygen? 16. What is the difference in color between the pure and the impure blood? 17. What is carbonic acid gas? 18. Where does the impure blood get this carbonic acid gas? 19. Is it harmless or poisonous? 20. What becomes of the carbonic acid gas which the blood has taken from the tissues? 21. What is meant by the clotting of the blood? 22. Of what great importance is the clotting of the blood? 23. How can we stop the bleeding from a wound of large size? 24. What is meant by fainting? 25. What should be done to a person who has fainted?

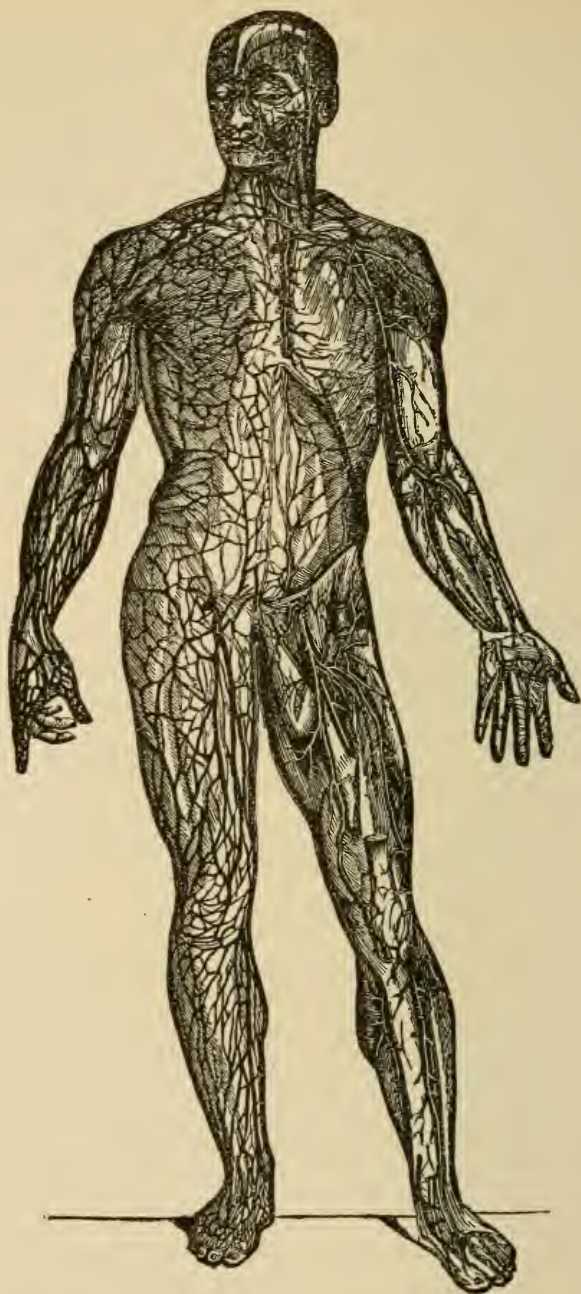


FIG. 74.—The Blood-vessels. In the right half of the figure the arteries are shown; in the left half, the veins.

LESSON XVIII.

HOW THE BLOOD IS FORCED THROUGH THE BODY.— THE HEART AND BLOOD-VESSELS.

196. Thus far we have been speaking of the blood itself. Now we will study how the blood flows through the body, for our *blood is constantly moving*. This we can see very well in the frog (Fig. 75). If we



FIG. 75.—The Blood in Motion, as Seen in the Small Blood-vessels of the Frog's Foot.

take some part of the frog, as, for instance, one of the thin parts of the foot, and spread it out and look at it under the microscope, we shall see the blood in motion. If we examine the thin part of the frog's foot in this way we shall see a number of tubes, and

in the centre of each tube a moving fluid full of small round bodies, the *blood-globules*. This motion has been given to the blood by the *heart*.

197. **The Heart.**—The heart (Figs. 76 and 77) is the

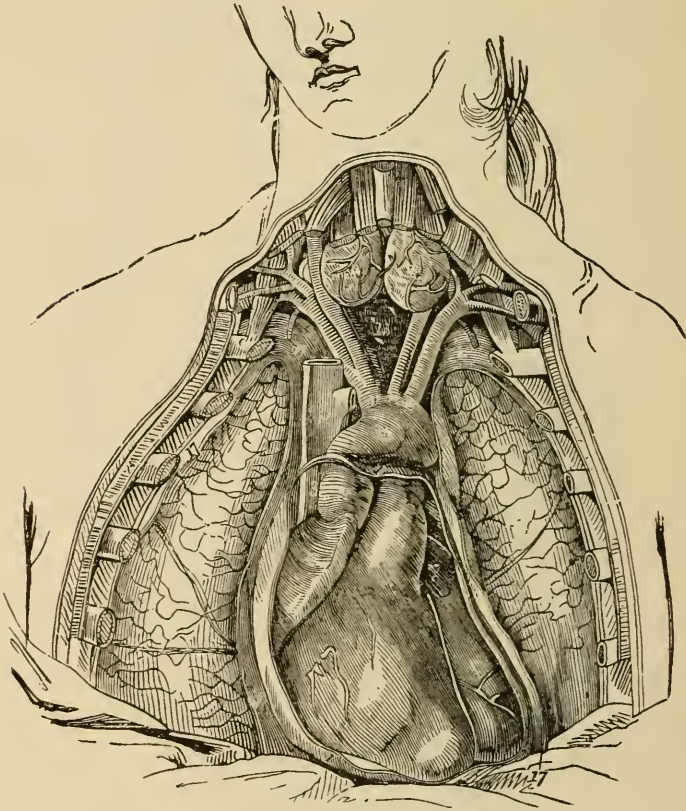


FIG. 76.—The Heart in its Natural Position. On each side the lungs are seen. Above, the large vessels spring from it. In order to see all this the front of the chest is represented as having been removed.

most important organ in the body. It is placed in the chest, between the lungs, and is covered in front by the breast-bone. It projects beyond the breast-bone on each side, but more to the left than to the right. It is shown in its natural position in Fig. 76.

198. The heart is shaped like a *cone*, with the wide part above and the point below. If the hand be placed upon the front of the chest on the left side, the beating of the heart can be felt.

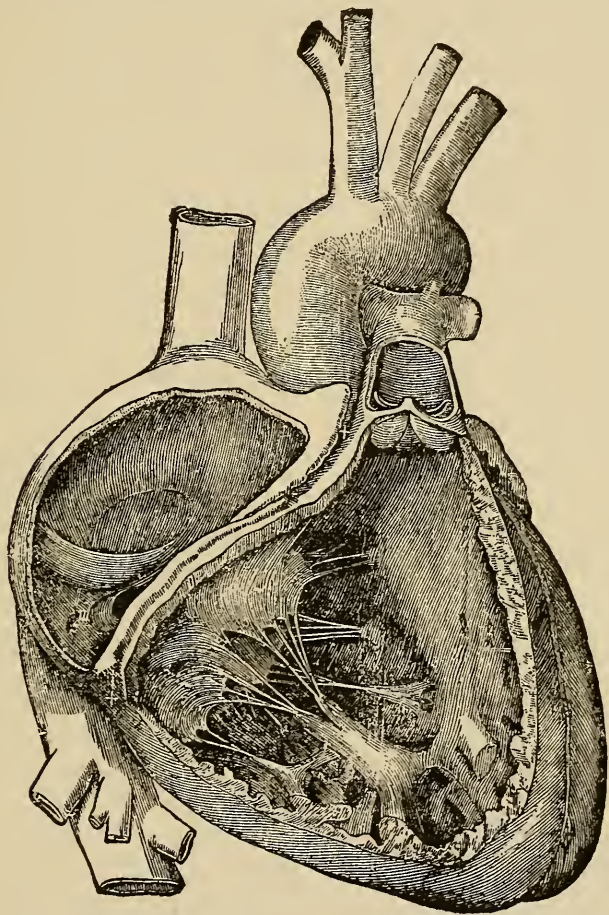


FIG. 77.—The Heart (the Front has been removed), Showing the Interior.

199. The heart is surrounded by a loose *sac*. Its walls are formed of *muscle tissue*. It is *hollow* so as to have *spaces* for the blood (Fig. 77). There are four such spaces, separated by partitions; two spaces are on the left side of the heart and two on the right side.

200. **The Work of the Heart.**—The heart serves to *pump the blood* into the blood-vessels with such force that it flows all through the body. The walls of the heart are made of muscle, and this muscle is constantly contracting; each time it contracts we say it *beats*. When it does this, the whole heart becomes smaller, and its cavities become smaller, and thus the blood is forced out. The heart then expands again and becomes wider, and the blood flows in until the heart becomes filled. These actions are being constantly repeated. The heart beats about *seventy times per minute*.

201. **The Course which the Blood Takes.**—Let us follow the blood as it passes out of the heart, and study where it goes and how it finally reaches the heart again. The dark or impure blood all passes to the *right side of the heart* and is pumped into tubes which carry it into the *lungs*. Here it is led into the very finest tubes and meets the air; it takes oxygen from the air and gives to it the poisonous carbonic acid gas. Thus in passing through the lungs it has become *purified*, and it changes from a dark red to a bright red color.

202. The purified blood then leaves the tiny tubes and enters larger ones which carry it back to the *heart*. But this time it passes to the *left side of the heart*. When the heart contracts the next time this purified blood is pumped into vessels which carry it to the different parts of the body.

203. **The Arteries.**—Those blood-vessels which take the *purified blood* from the heart and distribute

it to all parts of the body are called *arteries*. The blood-vessels which return the impure or used-up blood from the tissues to the heart are called *veins*. Between the smallest arteries and the smallest veins are the very finest blood-vessels, which are called *capillaries*. So that the blood, after being purified, passes through arteries, then capillaries, then veins.

204. How the Arteries Divide.—Each large artery soon divides and subdivides, and these branches pass in many different directions, constantly giving off smaller branches. A tree forms a very good example of how the arteries run in the body; the large trunk of the tree corresponds to the large artery which leaves the heart, and the branches of the tree correspond to the branches of this artery.

205. The Pulse.—When you are sick, and the doctor is called, one of the first things he does is to feel your pulse. He will put his finger upon your wrist and he will take out his watch. He is counting your *pulse*. If you put your finger upon your own wrist, in front, on the side on which the thumb is, you will feel something beating. This is an artery, and the beating you feel is your pulse. Every time the heart beats the arteries beat, and this gives what is called the pulse. This will be understood if it be remembered that every time the heart contracts it pumps blood into the arteries, and every time another heartful of blood is forced into the arteries, being elastic, they expand and grow wider. It is this expansion which is felt with your finger, and which is called the pulse. When the doctor counts the pulse

he can tell how slowly or how rapidly the heart is beating ; for the pulse is the same in number as the heart-beats. The reason we usually take the pulse at the wrist is because it is most convenient ; but there is a pulse in every artery of any size in the whole body. You can feel one at your temples, one at the side of your neck, and in many other places.

206. The Capillaries.—These are the very smallest blood-vessels, and they connect the arteries with the veins. We find the capillaries almost everywhere. They are so small that we cannot see them without the use of the microscope. If you scratch yourself and a little blood comes, this is from some of the capillaries, not from an artery or vein ; for if an artery or vein is injured it is more serious. It is while the blood is passing through the capillaries from the arteries to the veins that the tissues take from it the oxygen and give up to it the poisonous carbonic acid gas. And after this change has taken place, the blood is *impure* and its color changes from bright red, as it was in the arteries, to a *dark red*.

207. The Veins.—After the blood has passed through the different tissues by means of the capillaries, these unite to form the smallest veins, and many of these join to form larger ones, until finally we have a single large vein, just as we had a single large artery. But there is this difference : the artery started from the heart and went to the tissues ; the veins start in the tissues and gradually join into larger ones which go to the heart. The arteries, too,

contain bright red, pure blood ; the veins are filled with dark red, impure blood.

208. **How to Have a Good Circulation.**—If we wish to be in good health, the flow of blood must be *brisk*. Another name for the flow of blood is the *circulation*. If it be sluggish, we are apt to suffer in all parts of the body, because no part gets as much blood as it should. *Exercise* is the great medicine for a good circulation. Any good form of exercise will answer, but *exercise in the open air* is the best, because while we are making our blood go faster, we are also getting more oxygen to the tissues and building them up quicker.

209. **Effects of Alcoholic Drink upon the Heart and the Circulation.**—Alcoholic drink passes into the blood and irritates the heart, and as a result the heart may become too large. It might be thought that there would be no objection to having the heart too large, but this is not so. For when the heart is not of the right size it does not act properly and sickness results. The heart of a drunkard often contains a large amount of fat, which *weakens it*, and it then has not power enough to force the blood into the arteries properly, and the different parts of the body receive too little blood and become pale and thin.

210. You may have noticed the *flushed face* which some people have after drinking. This is because the alcohol drives the blood into the blood-vessels of the skin ; this takes blood from other parts which are more important, and these suffer.

211. The *arteries* of the confirmed drunkard may become so *changed* as to be *brittle*. When this change takes place in the arteries of the brain they are liable to rupture. This is called *apoplexy*, and it often causes the person to fall down dead. Of course apoplexy may occur in persons who are not drunkards, but it does occur often in drunkards.

212. **Effects of Tobacco upon the Heart.**—The use of tobacco very often affects the heart and causes it to throb so that the person feels it and is very much annoyed by it. This is called *palpitation of the heart*. It often causes the heart to beat too quickly and then too slowly ; sometimes too strongly and then too weakly. All these effects are so common that such an irregular heart due to tobacco is recognized by doctors as *tobacco heart*. Of course, the circulation cannot be carried on properly if the heart acts so irregularly.

QUESTIONS.

1. What is the most important organ in the body? 2. Where is the heart situated? 3. What is the shape of the heart? 4. Where can we feel the beat of the heart? 5. By what is the heart surrounded? 6. Of what kind of tissue are the walls of the heart formed? 7. Is the heart solid or hollow? 8. What usually fills these spaces in the heart? 9. What work does the heart perform? 10. What do we mean when we say the heart beats? 11. What does the heart do when it beats? 12. About how often does the heart beat per minute? 13. Describe the course which the blood takes. 14. Where does the impure blood pass to from the right side of the heart? 15. Where from the lungs after it is purified? 16. Where does the purified blood next go from the left side of the

heart? 17. What are the arteries? 18. How do the arteries divide? 19. What is meant by the pulse? 20. Where do we usually take the pulse, and why? 21. How can we feel the pulse? 22. What is the cause of the pulse? 23. What are the capillaries? 24. What changes take place in the blood while it is passing through the capillaries? 25. What are the veins? 26. What sort of blood do the veins contain? 27. What sort of blood do the arteries contain? 28. What is the circulation? 29. What happens when the circulation is sluggish? 30. What effect has exercise upon the circulation? 31. What kind of exercise has the most beneficial effect upon the circulation? 32. What are the effects of alcoholic drink upon the heart? 33. What is the flushed face after drinking due to? 34. What is apoplexy? 35. What are the effects of tobacco upon the heart in some persons? 36. What is meant by a tobacco heart?

LESSON XIX.

THE VOICE.—HOW WE PRODUCE SOUNDS AND TALK.

213. **Respiration.**—Another name for breathing is *respiring*, and hence the act of breathing is called *respiration*. When air is taken into the lungs we *breathe IN* or *INSpire*; when the air passes out again, we *breathe OUT* or *EXspire*.

214. **How the Air Reaches the Lungs.**—When we inspire, the air first passes through the *nose*, then into the *throat*, next into the *larynx*, the organ in which sounds are produced; then it passes through a tube running down the front of the neck, called the *windpipe*, and this leads to the *lungs* (Fig. 79).

215. **The Larynx.**—The larynx is the organ which produces *sound*. It is a triangular box, with stiff, hard walls (Fig. 78). It is placed at the upper end and front part of the neck, and can readily be felt just below the chin. This pointed part is called Adam's apple.

216. **The Vocal Cords.**—If we look into the larynx we will find that there is a sort of shelf projecting on each side, and that these two shelves can be moved; sometimes they move toward the middle and meet each other, at other times they separate, and then there is a large space between them. They are called the *vocal cords*, because they produce the voice-sounds by their motion.

217. **How Sounds are Produced.**—Previous to

making a sound we always take a deep breath. Then this air is blown out again ; as it passes through

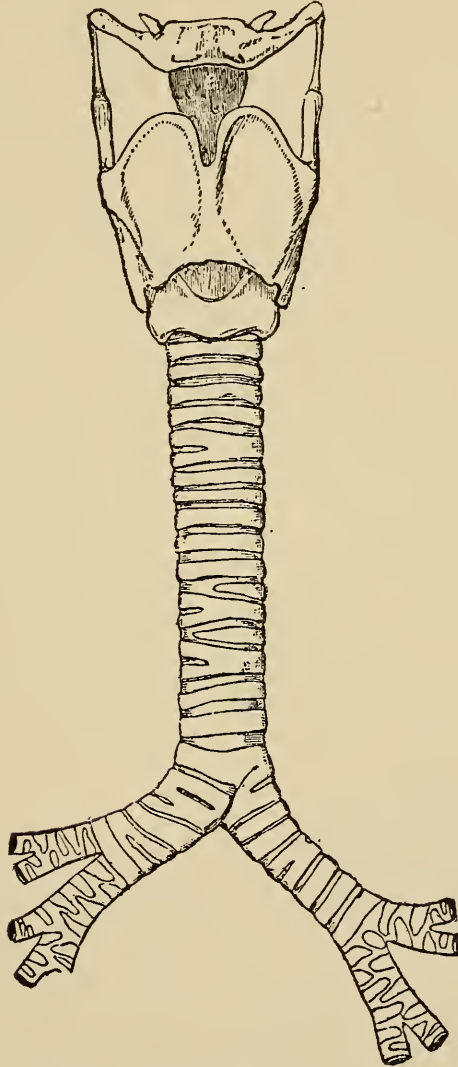


FIG. 78.—The Larynx and Windpipe.

the larynx, between the vocal cords, it makes these *vibrate*, and through the rapid motion of the vocal cords sound is produced.

218. It depends very much upon how the vocal cords are placed what kind of sound is produced. If the vocal cords are brought closely together and are made very tight the sound will be high. If you could look into the larynx of a lady with a soprano voice, while she is singing, you would find the vocal cords very close together ; if, on the contrary, the sound is produced while the cords are farther apart and less tense, the sound will be low, like that of a bass voice.

219. **Speaking.**—Although sound is produced in the larynx, it is changed by other parts, principally the throat, the mouth, the tongue, and the lips. These change the sound so that words are spoken. With the vocal cords alone we could make sounds as in singing ; but to speak, we must change these sounds by means of the parts already mentioned. For instance, in pronouncing the word paper, the manner in which the lips come together will be noticed ; if the word law be pronounced, the tongue will touch the top of the mouth.

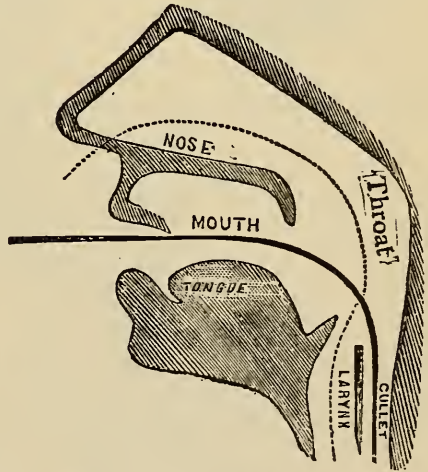
QUESTIONS.

1. What is another name for breathing? 2. What is the meaning of the word inspire? 3. What is the meaning of the word expire? 4. What is the meaning of the word respiration? 5. Through what parts does the air pass in reaching the lungs? 6. What is the larynx? 7. What is its shape? 8. Where is it situated? 9. What are the vocal cords? 10. Of what use are the vocal cords? 11. How are sounds-produced? 12. If the vocal cords are brought tightly together what kind of a sound is produced? 13. How is sound changed so that words can be spoken? 14. What parts change the sound in speaking? 15. Give an example.

LESSON XX.

BREATHING.—THE WINDPIPE AND LUNGS.

220. **The Windpipe.**—If the finger be passed along the front of the neck, from the larynx downward, a hard tube can be felt and traced down to the top of the breast-bone ; then it can no longer be felt, for it passes behind this bone into the chest. This hollow tube is called the *windpipe* (Figs. 78 and 81). It serves to conduct the air to the lungs after it has passed through the nose, throat, and larynx. After reaching the chest, the windpipe divides into two *tubes*, one of which carries the air to the right lung and the other to the left lung (Fig. 81).



221. **How Food is Kept Out of the Windpipe.**—The windpipe is placed in front of the tube through which food passes into the stomach. If you look at Fig. 79, you will see that the food must pass across the larynx and windpipe. You may wonder why it

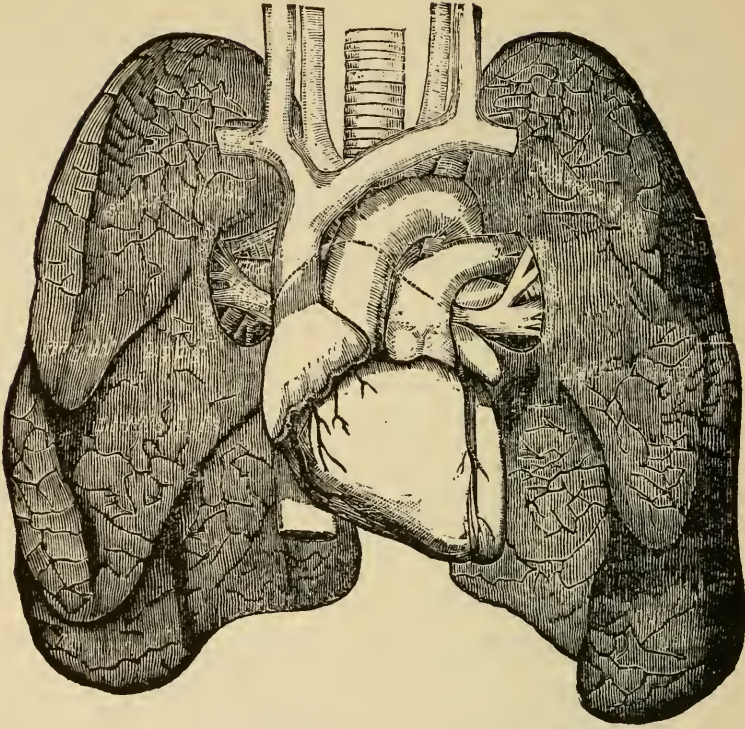


FIG. 80.—The Heart and Lungs. On each side the lungs are seen. In the centre is the heart. The striped tube above is the windpipe.

does not fall into these parts. Nature has provided against this.

222. At the upper part of the larynx there is a sort of *cover*, shaped like a leaf, which is pressed down so as to close the larynx whenever we swallow. If anything should happen to get past this cover, the vocal cords would close tightly and thus protect the windpipe.

223. Sometimes the food is swallowed unexpectedly, and the vocal cords forget to close; then we say the food has *gone down the wrong way*. This is very distressing, causing coughing until the piece of food is dislodged. In speaking or laughing during meals,

care should be taken that the mouth is empty ; otherwise this accident may happen.

224. **The Lungs.**—The lungs are *the organs with which we breathe*. The entire lung may be divided into halves, a *right lung* and a *left lung* (Fig. 80). The lungs and the heart fill up the entire space of the chest. On the outside the lungs are covered by a sheet of smooth, shining membrane, which also lines the inner surface of the chest ; in this manner the lungs can rub against the walls of the chest without pain or friction.

225. Each lung is shaped like a *cone*, with the point above and the broad part below (Fig. 81).

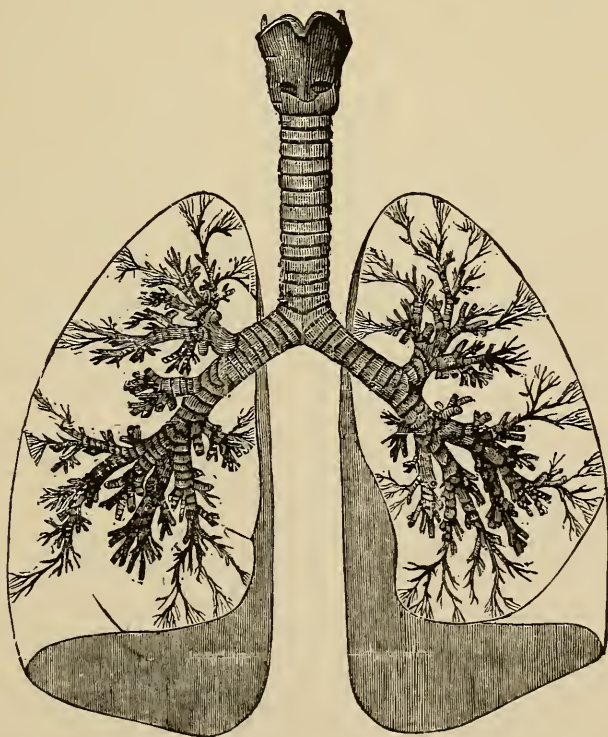


FIG. 81.—The Larynx, Windpipe, and Lungs. The lungs have been cut open to show the way in which the tubes from the windpipe branch.

226. **What the Lungs Consist of.**—The lungs are very light. If we cut into them, we find a large number of *tubes and spaces containing air*.

227. After entering the lungs, the tubes which leave the windpipe divide again and again, becoming smaller, until finally the branches have become so minute that they can no longer be seen without the microscope (Fig. 81).

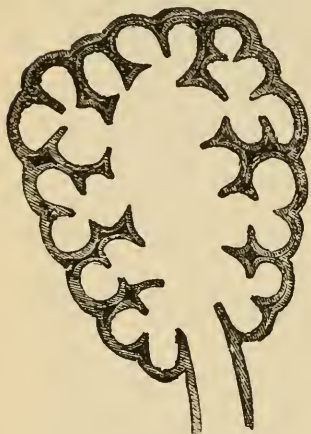


FIG. 82.—One of the Air-spaces of the Lungs.

228. Each of these minute tubes then ends in a *little bag containing air* (Fig. 82). The walls of these *air-spaces* are very thin and contain many tiny blood-vessels.

229. **Breathing.**—Like the beating of the heart, breathing takes place without the use of our will-power. It continues whether we are asleep or awake. It is possible to breathe faster than usual for a little while, or to hold the breath for a very short period, but not for long.

230. Usually we breathe about *twenty times per minute*. When we take a breath, the lungs become filled with air and expand; when we let out the air, the lungs again become smaller.

231. **Why Breathing is Necessary to Life.**—The object of breathing is *to purify the blood*. In breathing the blood takes oxygen from the air, and in exchange it gives it the poisonous carbonic acid gas, moisture, warmth, and a second poisonous gas which will be described shortly.

232. The *moisture* which the air receives from the blood can easily be seen if you breathe upon the window-pane ; and in winter you can notice the moisture in the air which we expire, because it becomes visible as soon as it meets the cold air. You can easily convince yourself that the air which we breathe out is *warmer* than that which we inspire ; this is because it has taken some of the heat from the blood.

233. **The Air of Crowded Rooms.**—When we breathe out, the air takes from the blood a certain *poisonous gas* which has a *disagreeable odor*. The exact nature of this unnamed gas is not known except by its smell. If you come from the open air into a crowded room you find it disagreeable to breathe for a little while, because the air does not seem fresh ; you call it *close*, and if it is very bad, you say it is *foul*. It is fortunate that this exceedingly poisonous gas has a bad smell, for otherwise we would not know that the air was no longer fresh and needed changing. If we stay in such a close room we no longer notice the smell, because we have become accustomed to it.

234. **Always Breathe Through the Nose and not Through the Mouth.**—In breathing, the air should be drawn *through the nose* and not through the mouth (Fig. 79). Many children breathe through the mouth ; this is an injurious practice which results in keeping the mouth open constantly, giving rise to a stupid expression of the face, and allowing the air to reach the lungs before it has been properly warmed.

235. Do not Wear Tight Clothing About the Chest or Waist.—Tight clothing or tight lacing presses upon the chest, and does not allow the lungs to expand as they should ; in this way not enough air can enter the lungs and the body suffers. Besides, if children dress so tightly about the chest it will keep this part of the body from getting its proper shape and size (Figs. 9 and 10).

236. Tobacco-smoke Irritates the Lungs.—Tobacco-smoke is irritating to the lungs of many people, and makes them cough. The throat also suffers, and it becomes red and sore. Such a throat is called by the doctor smoker's sore throat.

QUESTIONS.

1. Where is the windpipe? 2. Where does the windpipe divide? 3. Into what organ does the windpipe carry the air? 4. Is the windpipe in front of, or behind, the gullet? 5. How is food prevented from entering the windpipe? 6. What do we mean when we say that food has gone the wrong way? 7. What is the work of the lungs? 8. Where are the lungs? 9. How can the lungs be divided? 10. What is the shape of each lung? 11. What covers the lungs on the outside? 12. What do the lungs consist of? 13. What becomes of the branches from the windpipe? 14. What air-spaces are there in the lungs? 15. Does breathing stop at any time during life? 16. How often a minute do we usually breathe? 17. What change takes place in the size of the lungs when we take a breath? 18. Why is breathing necessary to life? 19. What changes take place in the air during breathing? 20. How can we prove that the expired air contains moisture? 21. Which is warmer, the inspired air or the expired air? 22. What is the nature of the air in crowded rooms? 23. What is the disagreeable odor found in

close rooms due to? 24. Ought we to draw the air through the nose or through the mouth? 25. What objection is there to breathing through the mouth? 26. Why is it injurious to wear tight clothing about the chest or to have the waist tightly laced? 27. What effect has tobacco-smoke upon the lungs of many people? 28. What effect has smoking upon the throat of many persons?

LESSON XXI.

HOW THE AIR IS PURIFIED.—FRESH AIR.— VENTILATION.

237. **Effects of Impure Air.**—Much time spent in close rooms produces a sleepy, dull, and tired feeling; the color suffers, and we no longer look bright. The blood cannot be purified in such bad air. In this way all the tissues of the body become pale and weak, and the organs no longer work as they should.

238. **Purification of the Air.**—If the air is constantly being made impure by our breathing, it would seem quite natural to ask, Why is it that the air does not become so impure after a while that we cannot live in it? This would result if God had not provided two great purifiers—*sunlight* and *plants*. These are the great *natural purifiers* and change the bad air, making it as good as it was before. You have no doubt noticed how stale it smells in all dark places, such as cellars. This is because the sunlight never enters to purify the air.

239. The way in which the plants purify the air is quite wonderful; *they make use of the poisonous gases as their food*.

240. **How Plants Live and Grow.**—Plants breathe in *poisonous gases* from the air and *breathe*

out pure oxygen. Besides the poisonous carbonic acid gas which they take from the air, they also absorb moisture and salts from the ground. From all these plants form their stems and leaves, and they grow until we could hardly believe that the big tree has grown from a small plant with no other nourishment than what has just been mentioned. In order to do this, plants must have *sunlight*—they will not grow in the dark. So that what is poisonous to the animal is food to the plant. And in this way pure oxygen is returned to the air and the poisonous carbonic-acid gas is gotten rid of.

241. **Ventilation.**—Ventilation means allowing impure air to escape from our rooms and letting fresh air take its place. This is very necessary. If a man were locked in a room and everything were tightly closed so that no fresh air could enter, no matter how much food and drink he had, he would soon die, because his breathing would be constantly making the air of the room more and more impure; finally he would die from want of pure air.

242. **How to Ventilate Rooms.**—In summer it is quite easy to ventilate our rooms, for all we need to do is to open the windows wide; the fresh air will then stream in and the impure air escape at the same time. But in winter it is more difficult; for the outside air, while it is fresh and pure, is also cold; and if we opened the windows very wide, we would feel uncomfortable. It is fortunate that our windows are not, as a rule, very tight-fitting; hence, more or less air gets in through the cracks. But it is well to

draw down the window a little from the top, for the foul air is lighter than the fresh air and is always found near the ceiling of the room.

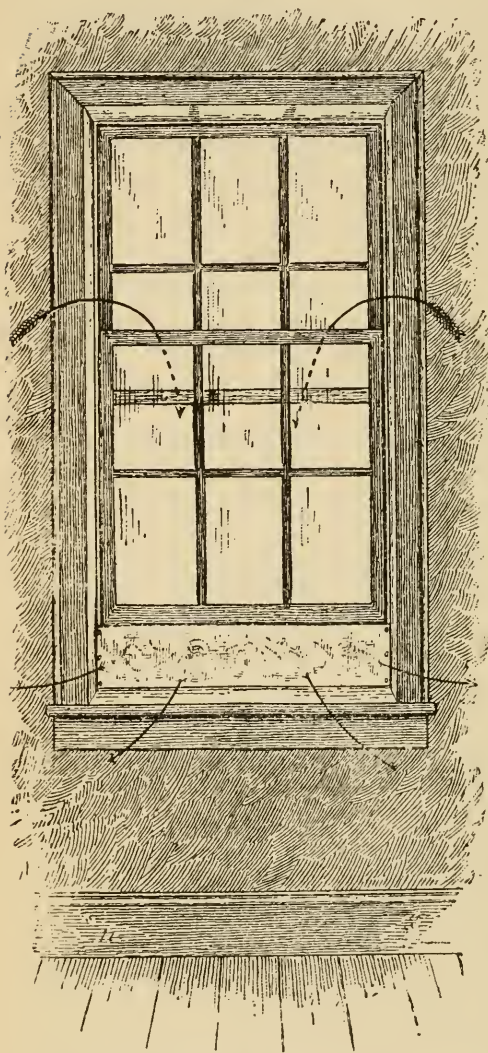


FIG. 83.—An Easy Method of Ventilating Rooms. The arrows above show how the impure air escapes. Those below, show how the fresh air enters.

243. Another very good way of ventilating a room is to push up the lower window about six inches and to fasten a piece of board in front of the open space which you make in this way. Or instead of a board a piece of canvas will be better yet, and it can be made to look nice by painting or embroidering on it. In this way the fresh air will come in through the canvas below, and the foul air will go out in the opening between the upper and lower portions of the window, as is shown in Fig. 83.

244. Certain methods of heating rooms are also valuable as means of ventilating them. The open-grate fire is one of the best means of supplying warmth, because it furnishes

such a ready escape for the impure air, which passes up the chimney.

245. In ventilating rooms it must be remembered that there should be no draughts of air upon the persons in the room, for otherwise they will catch cold. And also that a room cannot be healthy if no sunlight ever enters it. In some of our houses, and especially in what we call flats, many of the rooms are dark and never have any sunlight; these must be unhealthy, and the air in them can never be so pure as in light rooms.

QUESTIONS.

1. What effect has impure air upon the body? 2. How is the air purified? 3. What are the two great purifiers of Nature? 4. How do plants purify the air? 5. What does the food of plants consist of? 6. Can plants thrive without sunlight? 7. What is meant by the term ventilation? 8. Could we live in a room if the air were never changed? 9. Why not? 10. How can we ventilate our rooms in summer? 11. What is a good method of ventilating rooms in winter? 12. In what part of the room do we find the greater part of the impure air? 13. Why are cold draughts injurious? 14. What effect has sunlight upon the air of a room? 15. Can rooms in which sunlight never enters be healthy? 16. Why is the open-grate fire such a good way of heating a room?

LESSON XXII.

OUR OUTSIDE COVERING.—THE SKIN.

246. **The Skin** forms a soft, elastic layer which covers the entire body. It is thick at certain places where the body is very much exposed, or where there is much friction, as in the palms of the hands and the soles of the feet. In other places, which are more protected, it is quite thin; as, for instance, the inner side of the arm.

247. **Why the Skin is Very Sensitive.**—In another lesson we will read about certain tiny threads called *nerves*. A great many of these exist in the skin and end here in little knobs. Some of these nerves give rise to *pain*; this is very useful, as it protects the body and tells you when to be careful. If you are holding a lighted match in your fingers, you will drop it as soon as it burns down to your finger-tips, because there is pain. If there were no pain to warn you, the ends of the fingers might have been burnt, before you were aware of it. With these nerves we are enabled to feel whether anything is smooth or rough, sharp or dull, cold or warm, soft or hard. The finger-tips are intended as the organs of touch.

248. **The Two Layers of the Skin.**—The skin is formed of two layers, an outer and an inner. The outer skin is formed of a great many *scales* or flat

cells covering each other; these cells are being constantly rubbed away and cast off, and are then replaced by new ones. In taking a bath, it will be noticed that, in drying, a little of the skin comes off; this represents the dead cells which are cast off.

249. **The Finger-tips.**—If you look at the skin of the palms of the hand, and especially at the tips of



FIG. 84.—The Two Layers of the Skin. Above are seen the scales of which the outer layer consists.

the fingers, you will see fine lines arranged in circles. If you examine these with a magnifying-glass it will be seen that the lines are raised; it is here that the nerves of feeling end in great numbers.

250. **Parts of the Skin.**—Upon examining the skin we find in it, or attached to it, *perspiration tubes*, *oil tubes*, *hairs*, and, in certain parts, *nails*.

251. **The Perspiration Tubes and the Pores.**—The perspiration tubes are small tubes in the skin,

which give off *perspiration* (Fig. 85). Where they open upon the skin is a small space called a *pore*.



FIG. 85. — One of the Perspiration Tubes and Pores of the Skin.

There are thousands of these pores in the space of every inch of the skin. This shows the necessity of keeping the body clean, so that the pores remain open, for otherwise the perspiration cannot escape.

252. The Perspiration.—Perspiration is being constantly given off from the body, day and night. Most of the time, especially when the weather is cool, it is invisible. But if more than the usual amount is given off, it collects in drops; this occurs in summer and at other seasons of the year when we become overheated or work hard. Perspiration consists largely of water; and in the water certain mineral *salts* and certain *poisonous matters* which it is necessary for the body to get rid of, are dissolved.

253. The Oil Tubes.—Besides the perspiration tubes, there are others which run through the skin and open on or near its surface. These tubes give off a certain *oily* substance which keeps the skin soft and movable, without which the skin would get dry and cracked. This oily matter also serves to keep the hair glossy and soft; and we find the greatest number of oil tubes where there is hair. It is to remove the oily matter which has become stale and has attracted dirt that we need soap in washing.

254. **The Hair.**—If a hair be examined it will be found that one end is pointed, while the other, which was attached to the skin, has a white knob; this is

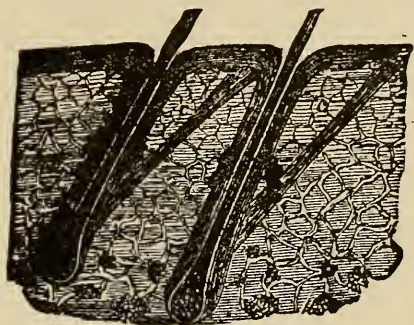


FIG. 86.—Two Hairs. Showing the manner in which the hairs are attached to the skin.

the *root*, and it is through this that it is fastened to the skin (Fig. 86). The hair is not solid, but is a tube filled with a soft material.

255. **The Nails.**—At the end of the fingers and toes are the *nails*. They are hard and horny, and serve to protect the finger-tips and give them firmness. In front they have no feeling, and we may cut them



FIG. 87.— Proper and Improper Method of Trimming the Nails. The figure to the left exhibits the proper method—cut off squarely; that to the right the improper method—cut off round and close.

without pain to us. But farther back they are very firmly attached, and here they are very sensitive.

256. **The Care of the Nails.**—The nails should be cut with scissors at regular intervals. They should

not be cut too close or else the finger-tips and the ends of the toes will become sore. Many persons have sore toes, especially the big toe, because they do not cut the nail properly. The nails should be *cut straight across* and not rounded (Fig. 87). The finger-nails should not be bitten off.

QUESTIONS.

1. Is the skin of the same thickness throughout the body?
2. At what points is it the thickest?
3. Why is the skin very sensitive?
4. Of what use are the nerves of feeling?
5. Of how many layers is the skin formed?
6. Of what is the outer layer formed?
7. What becomes of the scales which form the outer layer?
8. What lines do we see on the tips of the fingers?
9. What parts are found in or attached to the skin?
10. What are the perspiration tubes?
11. What are the pores?
12. What is perspiration?
13. Why is it necessary that perspiration be given off from the body?
14. What are the oil tubes?
15. What are the uses of the oil tubes?
16. Why must we use soap in addition to water in cleansing the body?
17. Describe a hair.
18. How is hair attached to the skin?
19. Of what use are the nails?
20. How should the nails be trimmed?

LESSON XXIII.

THE CARE OF THE SKIN.—BATHING.

257. You will now appreciate how important the skin is, and why it is necessary to keep it in good condition; if you wish to be *healthy*, you must be *clean*. *Cleanliness is next to Godliness* is an old and true saying. Dirt is, as a rule, a sign of ignorance; and those nations are usually the dirtiest which are the most backward in civilization. On the other hand, the more civilized people are, the cleaner do they keep themselves. There are few things that cause so much disease as uncleanness and filth.

258. **The Results of Uncleanliness and Filth.**—Whenever you read of outbreaks of cholera and such diseases, you will always find that they occur in parts of cities which are overcrowded and filthy. This was shown in the last outbreak of cholera many years ago in New York. It is easy to understand why this should be so. The pores of the skin are the openings by which the body gets rid of waste materials, just as the sewer-pipes of a city carry off the refuse. Suppose the sewer becomes stopped up in a large city, what trouble it causes! What dirt! What a stench! In the same way, when we allow the dirt to cover the pores of our skin, the poisonous materials cannot escape, and the body suffers.

259. **Bathing.**—It is not sufficient to wash the hands and face daily; we should wash off the entire body at least once a week. If you shake out some of your underclothing at night, you will find a great many small white flakes fall to the ground. They represent the uppermost layer of the skin which is constantly being cast off in these small particles and replaced by the deeper layers. The entire body is covered with these scales, and it is necessary to remove them often. Some fall off by themselves, but others must be removed by soap and water. Consequently, at least once a week we should take a warm bath, and use soap in it, for this removes the stale, oily matter also.

260. **Cold Baths.**— Besides the warm bath for the sake of cleanliness, we take cold baths, especially in summer, because they are *refreshing and strengthening*. After taking a cold bath it is well to rub the body with a coarse towel so as to make the skin glow and tingle. This causes the blood to circulate faster, and increases our strength and appetite. It is injurious to remain in a cold bath until you begin to shiver. As soon as you *begin to feel chilly you should go out*.

261. *Never bathe directly after a meal; wait two or three hours. If you are overheated and perspire freely, it is better to wait until you are somewhat cooled off before you go into cold water. Always wet the entire head as well as the rest of the body when bathing.*

262. **Powder.**— The use of powder and like substances upon the skin is injurious. These substances

stop up the pores and make the skin rough and ugly. Besides, many of them are poisonous, and this poison may get into the blood through the skin and poison the body. Powdering the face is not done by the better class of people.

QUESTIONS.

1. Why is cleanliness so very important? 2. Of what is dirt a sign as regards civilization? 3. How often should the entire body be washed? 4. Why should the entire body be washed frequently with soap and warm water? 5. What are the effects of a cold bath? 6. What should we do to make the circulation more brisk after a cold bath? 7. What is a sign that you have been in a cold bath long enough? 8. Is it well to bathe directly after a meal? 9. What other precautions should you take when bathing? 10. What effect has the use of powder and like substances upon the skin?

LESSON XXIV.

THE WARMTH OF THE BODY.—OUR CLOTHING.

263. Have you ever stopped to think how it is that on the coldest day in winter our bodies remain warm even though we go out into the open air? You may say it is due to the clothing we wear, but this is not so. For if you took a cold stone and wrapped ever so much clothing around it, you could not warm it. Our clothes keep in the heat of the body, but they cannot produce any.

264. **What Causes the Warmth of the Body.**—The warmth of the body is caused by the *food* which we eat and the *oxygen* of the air which we breathe. These serve as *fuel*, just as coal and wood form the fuel in a stove. This human fuel is changed so that it can be used by the various parts of the body. The tissues of the body are used up in performing the *work* required of them and in keeping the body *warm*; they are constantly being built up again by the nourishing materials which the blood conveys to them.

265. **Warmth of the Human Body.**—The warmth of the human body is about ninety-eight degrees as measured with the *thermometer*. All of you have probably seen a thermometer. It is a long, hollow tube of glass, containing a silvery fluid called quick-

silver. Heat makes the quicksilver rise, and the more heat the higher it rises; so that we tell how hot anything is by the height to which the fluid in the thermometer rises, there being numbers attached to the frame of the instrument to express the heat. Ninety-eight degrees expresses the heat of our blood, and hence this is called *blood-heat*.

266. The Warmth of the Body Remains Constant during Health —The blood and the interior of the body have the same heat in summer as in winter, namely, ninety-eight degrees. In winter the skin, especially of the hands, may be quite cold, and yet the heat of the blood remains the same.

267. When sick with *fever*, the blood becomes hotter; if this increase in heat is more than a few degrees, it is very dangerous.

268. How we Keep Warm in Winter —In winter we depend upon *exercise*, *additional food*, and *warmer clothing* to keep us warm. You have noticed the car-drivers slap their arms about on a cold day; this is to give them exercise and make them warm; it makes the blood circulate faster, and this brings heat to the tissues. If we go out on a cold day before breakfast we feel very chilly; everyone knows how much better he can endure the cold after having had a warm meal. We wear warmer clothing in winter so as to prevent the warmth from leaving the body too quickly. *Woollen* clothing is the warmest. When it is cold, it is well to wear *flannel* next to the skin.

269. How we Keep Cool in Summer.—In summer we should eat less food, and particularly less

meat, than in winter. Usually our appetite is not as good in summer as in winter, and naturally, therefore, we take less food. We should have *light clothing*; *linen* is the coolest. Everything we do during the warm part of the summer days we should do slowly and without hurry. Never walk in the sun for any distance without being shaded.

QUESTIONS.

1. Can clothing produce any warmth in the body?
2. What effect has our clothing upon the heat of the body?
3. What causes the warmth of the body?
4. What is the natural warmth of the human body?
5. What is a thermometer?
6. What change is there in the heat of the body when we have fever?
7. How do we keep warm in winter?
8. How does exercise keep us warm?
9. In what manner do clothes keep us warm.
10. Are we apt to eat more in summer or in winter?
11. What should be done in summer to keep cool?
12. What sort of clothing is the warmest?
13. What sort of clothing is the coolest?

LESSON XXV.

ALCOHOLIC AND OTHER STIMULANTS.

270. A *stimulant* is something which excites the body or some part of it. Among the most common stimulants are coffee, tea, and liquids containing alcohol. Many drugs act as stimulants; ammonia and camphor are good examples of medicines which are taken for this purpose.

271. **The Proper Use of Stimulants.**—A stimulant may be useful in certain conditions of ill-health, when ordered by a physician. We hear frequently that a “tonic” has been ordered for some invalid in order to strengthen the body or to increase the power of the heart when it is weak. These are examples of the proper use of stimulants.

272. **Water and Food Act as Stimulants.**—A drink of cold water is probably the most common example of the use of a stimulant; everyone knows how a person who feels faint may become revived by this simple means. Food, especially in liquid form, and in such a state that it can be quickly digested and hence rapidly taken up by the blood, is an ideal form of stimulant; thus, a plate of hot soup, or gruel, or a glass of hot milk, is a useful stimulant.

273. **Tea and Coffee as Stimulants.**—Tea and coffee are stimulants which, if taken in moderate

quantity by adults, are not usually harmful and are often of service. Children are, however, better off without the regular use of tea and coffee; milk and water are the natural drinks for them.

274. These are all examples of stimulants which are, as a rule, harmless, and which are often of great value. We will now take up the study of a stimulant which is the cause of much ill-health, and of more unhappiness and crime than any other agent with which we are acquainted; this stimulant is *alcohol*.

QUESTIONS.

1. What is a stimulant? 2. Mention some of the most common stimulants. 3. When may a stimulant be useful? 4. Give an example of the proper use of a stimulant. 5. What form of food acts as an excellent stimulant? 6. How may water be used as a stimulant? 7. Under what circumstances are tea and coffee harmless stimulants? 8. Are tea and coffee suitable for children as regular drinks? 9. What drinks are better for children than tea and coffee? 10. What objections are there to the use of alcohol as a stimulant?

LESSON XXVI.

ALCOHOL.

275. **The Early History of Alcohol.**—Alcohol is said to have been discovered about three thousand years ago. At that period chemists employed all their time in trying to discover two things: One was how to change the common metals into gold, and the other to discover a substance, an “elixir of life,” the taking of which would give everlasting strength and life, and prevent death. Alcohol was at first believed to be such an “elixir of life;” but it did not take the ancients long to find out, to their sorrow, that its effects were exactly the opposite.

276. **Alcoholic Drinks.**—Alcoholic drinks are so called because they contain alcohol. It is this substance which makes them *intoxicating*, that is, capable of making men drunk. They vary in the proportion of alcohol which they contain; in general we may say that the greater this proportion the more harm they do. Besides this difference in the amount of alcohol, there is also a variation in the flavor or taste of each, depending upon how it is made.

277. Some alcoholic drinks are sweet; some have no sugar; some are bitter. Some are dark, others are light in color. Some are sparkling because they contain escaping gas, and others are free from this. Some

are strong and others are weak. But these are merely variations ; in every case *the harm done depends upon the existence of alcohol and its amount.*

278. Non-alcoholic Drinks.—These are sometimes spoken of as “soft” or temperance drinks. They consist of water, flavored in various ways, and made sparkling by escaping gas. Such drinks are *harmless*, and since they contain no alcohol are *not intoxicating*. Unless taken too cold or in too large a quantity, they are not objectionable. As examples, we may mention ginger-ale, soda-water, sarsaparilla, and lemonade.

279. Alcohol.—Alcohol is a clear, colorless liquid, resembling water in appearance ; it will mix with water. It is lighter than water. It has a pleasant smell, but its taste is hot and burning. If we leave a little exposed in a saucer, we soon find that it has disappeared into the air, and we say it has “evaporated.” It takes fire easily, and burns with a faint bluish flame, which gives very little light, but considerable heat ; and all the alcohol is consumed without any smoke or soot. Alcohol is sometimes called *spirit*.

280. The Uses of Alcohol.—Alcohol is very useful to us in many ways. It dissolves a great many things which water will not dissolve. Oils and resins will not mix with water ; but alcohol dissolves them. The druggist uses it pure or mixed with water to extract the valuable parts of roots, herbs, barks, and leaves. In this way many *medicines* are made.

281. Alcohol will not freeze, no matter how cold it is ; hence it is used to fill the tubes of thermometers

which are to be used in very cold countries. It will preserve animal and vegetable tissues and keep them from becoming offensive and from rotting.

282. How Alcohol is Made.—Alcohol is derived exclusively from the *vegetable world*, and yet, during the life of plants, no alcohol can be detected. It is formed from the *starch and sugar* which plants produce, but not so long as the parts of the plants are in a natural condition. The sap of the sugar-cane is rich in sugar, but while rooted in the ground, and living, no alcohol is formed ; it is only when cut and crushed that alcohol makes its appearance. In the same manner, grain and vegetables contain much starch ; but so long as the outside covering remains intact no alcohol forms.

QUESTIONS.

1. What is meant by alcoholic drinks? 2. Why are they intoxicating? 3. What is meant by the word intoxicating? 4. Explain in a general way how alcoholic drinks vary? 5. What is the injurious part of alcoholic drinks? 6. By what other terms are non-alcoholic drinks known? 7. Give a number of examples of non-alcoholic drinks. 8. What is the appearance of alcohol? 9. What are some of the properties of alcohol? 10. In what ways can we make use of alcohol? 11. From what is alcohol derived? 12. Does alcohol exist during the life of plants?

LESSON XXVII.

FERMENTATION.

283. **Fermentation.**—The process by which starch and sugar are changed into alcohol is an example of what is known as *fermentation*. Sugar can be converted directly into alcohol ; but *starch must first become sugar* before fermentation will change it into alcohol.

284. If you take anything which contains starch, whether it be corn, rye, potatoes, or anything else, add yeast and water to it, and mix them, you will soon find that the starch in these substances has turned into sugar. If you allow the mixture to stand longer, and if you warm it slightly, little bubbles of gas will be seen escaping into the air ; we say it is *fermenting*. If any one has seen sweet cider becoming hard and then sour, he will have noticed the bubbles of gas rising ; this is an example of *fermentation*.

285. At the same time that this gas is given off we find the liquid is becoming less sweet than it was. After a time it will have lost all its sweetness and have the taste of alcohol. So that, first, the starch has been changed into sugar, and then the sugar has become changed into alcohol.

286. The alcohol remains in the liquid, while the

gas, which is poisonous, escapes into the air. Two poisons have taken the place of the starch or sugar which existed before. The gas, known as *carbonic acid gas*, is the same poisonous substance which is given off in the expired breath and which collects in damp cellars and old wells.

287. This process which changes sugar and starch into alcohol is but one form of fermentation, and is brought about by the growth of minute living bodies which are always present in the air and hence soon fall into any liquid which is exposed.

288. **Minute Living Bodies in the Air.—Germs.**—These minute living bodies are called *germs*. Millions of them are always present in the air. They are so small that it is only when a number of them are examined together, with a very strong microscope, that they can be seen. Most of them are harmless. Some give rise to fermentation; others cause liquids to become mouldy, to rot, or spoil; still others are responsible for all the contagious diseases, such as diphtheria, scarlet fever, measles, etc. In every case these germs, as they are called, grow and multiply with enormous rapidity, and in doing so they produce *fermentation, rotting, or contagious diseases*.

289. **There are Different Kinds of Fermentation.**—If a watery liquid containing vegetable substances be exposed to the air in a warm place, it soon spoils; this is because germs from the air have fallen into the liquid, have grown there, and in doing so have produced the changes which we call *spoiling*; this is one kind of fermentation. The change of

starch and sugar into alcohol is another kind. If we expose cider or wine to the air in a warm place, the liquid will become sour and turn into *vinegar*; this is another form of fermentation.

QUESTIONS.

1. Give an example of fermentation. 2. Can starch be changed directly into alcohol? 3. Into what substance must starch first be changed before it can form alcohol? 4. Describe the process of fermentation by which alcohol is produced. 5. What is formed besides alcohol? 6. What change is there in the sweetness of the liquid? 7. What becomes of the poisonous gas which is formed? 8. What can you say about the living bodies in the air? 9. What are they called? 10. What is their size? 11. What different processes do they give rise to? 12. Give examples of different kinds of fermentation.

LESSON XXVIII.

ALCOHOLIC DRINKS.

290. **Yeast.**—In the case of that kind of fermentation which produces alcohol, the minute living body which causes it is known as the *yeast plant* or *yeast*.

291. **How Alcoholic Drinks are Made.**—In changing starchy or sugary solutions into alcoholic

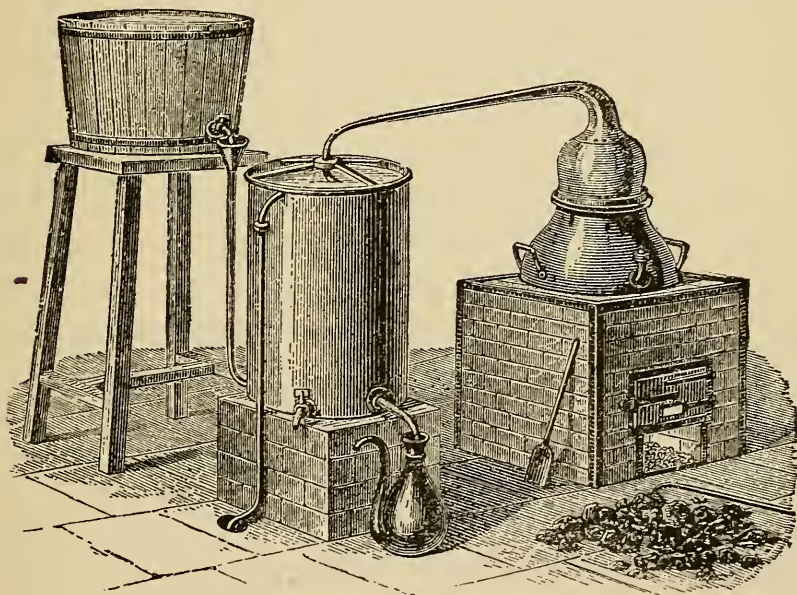


FIG. 88.—A Still Used in Making Certain Alcoholic Drinks.

liquids it is often more convenient and hastens the process to add a little yeast, than to take the chances that some such germs will fall in from the air. So much yeast forms when beer is made that the surplus

is sold in large quantities by brewers. Yeast has one very important and familiar use in the making of bread.

292. After the liquid which is to be an alcoholic drink has been fermented, it requires clearing and flavoring. If the drink is to be wine, beer, ale, porter, or cider, this is done by allowing the liquid to stand, and pouring off the clear part and straining it. If it is to be one of the liquors, whiskey, brandy, rum, and the like, the liquid is placed in a large vessel, called a *still* (Fig. 88), and heated. The heat drives off the alcohol, some of the water, and some flavoring matter; these are collected and make *liquor*.

293. **Distillation.**—This process, by which a fluid is turned into a vapor and then collected again in the form of a liquid, is called *distillation*. Cold hastens the return of the vapor to a liquid form. If you breathe upon a pane of glass in winter, moisture will collect. This is the moisture contained in the expired air which is condensed by the coldness of the window-pane. If pure alcohol is wanted, it must be driven off by heat several times in succession, being collected again each time.

294. **Varieties of Alcoholic Drinks.**—All alcoholic drinks are intoxicating in proportion to the amount of alcohol which they contain. They can be divided into five classes:

1. Malt Liquors or Beers.
2. Cider.
3. Wines.
4. Distilled Spirits or Liquors.
5. Cordials.

295. Malt Liquors.—Beer, Ale, Porter, and Stout.—These contain from *one-thirtieth to one-twelfth of alcohol*.

296. Beer.—Beer is made from *barley*. The barley grains are moistened and kept in a warm place until they sprout, that is, until the root and stem begin to form ; the object of this is to change the starch of the grain into sugar. As soon as sprouting commences, the barley is placed in an oven and heated so as to stop its growth. This forms *malt*.

297. The malt is crushed, mixed with hot water, and the mass allowed to stand. In this way the sugary portions of the malt are extracted or dissolved. It is then strained, and, after hops are added to give it the peculiar flavor of beer, and at the same time a slightly bitter taste, it is boiled.

298. Then it is drawn off, cooled to the ordinary temperature of the room by being surrounded by large quantities of ice, mixed with yeast, and allowed to ferment. After fermentation has proceeded to a certain point, the yeast is separated and the clear fluid is drawn into casks ; this is *beer*.

299. Ale, Porter, and Stout.—These are made in a similar manner. The dark brown color of porter and stout is produced by adding a quantity of charred malt.

300. Cider.—This is the fermented juice of *apples*. The fruit is crushed and the juice collected. At first it is *sweet* and contains no alcohol ; but it soon *ferments*, and its sugar changing to alcohol, it becomes less sweet and is called *hard*. After awhile, unless

protected from the air and heat, it undergoes further change, becomes *sour*, and forms *vinegar*. Cider contains about *one-twentieth of alcohol*.

301. **Wines.**—Wines contain from *one-tenth to one-fifth of alcohol*. They are made from *grapes*. The juice is pressed out and set aside in large vats. If there be much sugar present, the wine remains *sweet*. In other wines, nearly if not quite all the sugar becomes changed into alcohol; the wine then loses its sweetness and is known as a *dry* wine.

302. **Home-made Wines.**—A great deal of ignorance is displayed on the subject of *home-made wines*. Many people believe that because they have manufactured such wines themselves, they must be harmless and innocent. *Elderberry wine, currant wine, gooseberry wine*, and other home-made wines are *just as injurious* as those made from the grape. They contain just as large a percentage of alcohol as many of the wines made from grapes; and this being the case, they are *just as harmful*. It is the alcohol which constitutes the injurious portion of wines and of all other forms of intoxicating drinks.

303. **Distilled Spirits or Liquors.**—Liquors contain about *one-half alcohol*; they are the *most intoxicating* and the most dangerous of all alcoholic drinks. The proportion of alcohol is about the same in all of them; the only difference is in the flavor. This depends either upon the variety of grain or other substance used in the manufacture, or upon whatever flavoring agent is added afterward. *Whiskey* is made from corn or rye, and very cheap forms from potatoes.

Brandy is made from grapes and other fruits. *Rum* is distilled from molasses. *Gin* is flavored with juniper berries.

304. Many liquors are made *artificially* by mixing equal parts of alcohol and water, adding some flavoring, and enough coloring substance to give the proper appearance. Many of the substances added in this way are of a very injurious and poisonous character; thus other poisons are added to the alcohol.

305. **Cordials.**—These are clear, sweetened liquids, variously colored, containing about *one-third alcohol*; they are flavored with different oils, such as peppermint, anise, fennel, orange, etc. They are known by fancy French names. Some of them are distilled liquors to which considerable sugar has been added. Most of them are made artificially by mixing alcohol and water and then flavoring and coloring to suit.

306. Many of the much-advertised bitters, tonics, elixirs, and other patent medicines contain large amounts of alcohol. They are not only capable of doing great injury, but are deceptive, and thus often cause a craving for alcoholic drink in persons who were ignorant that they were taking what practically amounts to liquor.

QUESTIONS.

1. What is yeast?
2. What is it used for?
3. How are alcoholic drinks made?
4. What is a still?
5. What is distillation?
6. What different kinds of alcoholic drinks are there?
7. How much alcohol do malt liquors contain?
8. From what is beer made?
9. How is beer made?
10. What is malt?
11. What other kinds of

malt liquors are there? 12. What is cider? 13. How much alcohol does it contain? 14. What is the difference between sweet and hard cider? 15. What is vinegar? 16. From what are wines obtained? 17. How much alcohol do wines contain? 18. Why are some wines sweet and others dry? 19. Mention examples of home-made wines? 20. Why are home-made wines just as injurious as others? 21. How much alcohol do distilled spirits or liquors contain? 22. Why are they the most dangerous of all alcoholic drinks? 23. How do the various liquors differ? 24. From what is whiskey made? 25. From what is brandy made? 26. From what is rum made? 27. From what is gin made? 28. What additional poisons are found in liquors which are made artificially? 29. What are cordials? 30. How much alcohol do they contain? 31. What objection is there to the various bitters, tonics, and elixirs which we often see advertised? 32. What similar objection is there to many patent medicines?

LESSON XXIX.

THE EFFECTS OF ALCOHOLIC DRINK UPON THE BODY.

307. Alcohol in various forms is sometimes prescribed by the physician for use as a *medicine*; most doctors, however, realize how much responsibility attaches to their recommendation of liquids containing alcohol even for this purpose; for the alcohol habit is begun in some persons by the well-meant directions of the medical adviser. In certain fevers and wasting diseases, alcoholic drinks are prescribed not only as *stimulants* but also as *food*.

308. But because it may act as a food under such conditions, we are not justified in assuming that it can be used as a food at all times, for *ordinarily it does not act as a food*. It is intoxicating, and the very meaning of the word, which is derived from the Latin, signifying arrow-poison, indicates its nature.

309. **Alcohol is not Ordinarily a Food.**—The various alcoholic drinks contain no nutritious matter at all excepting beer, ale, porter, and stout, and these contain such a small proportion that we would be compelled to take a very large quantity to obtain a comparatively small amount of nourishing matter. If we did this, we would necessarily have to drink a large amount of alcohol. Hence, whatever value they might have on account of a small proportion of nour-

ishment, is neutralized by the injurious results of the alcohol.

310. One glass of milk, one plate of gruel, one slice of roast beef, or one cup of broth contains more nutrition than many glasses of beer, ale, porter, or stout.

311. **Alcohol does not Increase the Warmth of the Body.**—There is an erroneous idea, which is quite prevalent, that alcohol increases the warmth of the body. But it is a fact which has been proven over and over again that it has just the opposite effect.

312. There may be a *feeling of warmth to the body*, after alcoholic drink has been taken, but this is only on the surface and soon passes away, and then the *warmth of the body is lessened*. This was shown very well in several North-polar expeditions, where men who drank freely of liquor were frozen before the rest. Persons who are exposed to great cold know from experience that they do better without alcoholic drink.

313. Persons who use alcoholic drinks are less able to withstand the effects of great heat than are those who do not indulge. The testimony of Livingstone, the great African traveller, is, that in his exploring expeditions into the heart of Africa, exposed to the dangers of great heat and weakening fevers, those of his command who avoided alcohol showed the greatest amount of health and strength.

314. **Alcohol does not Increase the Strength of the Body.**—It is also a mistaken idea that alcohol increases the strength. Alcohol is the enemy of muscle tissue; it changes it into fat. Of all obstacles to the development of muscle, there is none greater

than alcohol. This is so well known that all persons who train in order to accomplish physical feats requiring unusual strength and the best of health, give up all use of alcohol. Even prize-fighters, limited as their intelligence usually is, have found this out from experience and give up alcoholic drinks when training. Experiments upon whole armies of men have shown that soldiers can do more work and better work when deprived of alcoholics.

315. Training —Let us stop to consider the meaning of the word training. To train means to live in the *most healthy way*; to go to bed early and rise early; to eat the most digestible and strength giving food; to take plenty of out-of-door exercise; to avoid all tobacco; and to abstain entirely from drink containing alcohol. All this is done to develop the muscles, so that one may be put in a fine and healthy condition and become as strong as possible.

316. Everyone has probably heard of the great boat-races which take place every year between Columbia and Harvard and between Harvard and Yale Universities. There is great rivalry between the colleges, and of course each likes to win the race. Each of these crews trains throughout the winter and spring until the day of the race, so as to become strong and increase the chances of winning. Every member leads a most regular life, and smoking and alcoholic drinks are absolutely forbidden.

317. Alcohol Weakens the Power to Resist Disease.—If a person who uses a good deal of alcoholic drink becomes ill with some serious disease, his

chances of recovery are very much fewer than if he had abstained; this is particularly the case with *pneumonia*, a disease of the lungs with a high fever. If such a person meets with an accident, it will take him longer to recover; in the case of a fracture, the ends of the broken bone unite with much greater difficulty than in ordinary cases.

318. The average length of life in persons who indulge freely in alcoholic drink is shorter than in others, and in the case of drunkards, it is very short indeed.

QUESTIONS.

1. For what purpose is alcohol in various forms sometimes prescribed by the physician? 2. In what other manner, except as a stimulant, may alcohol act when used as a medicine by the physician? 3. Is alcohol a food under ordinary circumstances? 4. Do most alcoholic drinks contain any nourishment? 5. In what kind of alcoholic drink is there a little nourishment? 6. Why cannot we make use of these forms of alcoholic drink for nourishment? 7. Is there more nourishment in a glass of milk or in a glass of beer? 8. Does alcohol increase the warmth of the body? 9. What effect has alcohol upon the warmth of the body? 10. How was this shown in North-polar expeditions? 11. What effect has alcohol upon the ability to withstand the weakening results of great heat? 12. How was this shown? 13. Does alcohol increase the strength of the body? 14. What effect has alcohol upon the muscles? 15. What is meant by training? 16. What is the life of a person in training? 17. Why do such persons adopt this mode of life? 18. Is alcohol or tobacco allowed to persons in training? 19. What effect has alcohol upon the power to resist disease? 20. What effect has alcohol upon the ability to recover from accidents? 21. What effect has the use of large quantities of alcoholic drink upon the length of life?

LESSON XXX.

THE EFFECTS OF ALCOHOLIC DRINK UPON THE DIFFERENT PARTS OF THE BODY.

319. Alcohol irritates the *stomach* and constantly makes it red ; after awhile the wall of the stomach becomes tough, and is no longer suited for its work. When a large quantity of alcoholic drink is added to the food, it prevents it from being digested. It often causes nausea and vomiting, and the vomited material will have the same form as when swallowed, showing that alcohol interferes with digestion. Drunkards suffer constantly from dyspepsia. Alcohol has the same irritating effects upon the *intestines*.

320. The *liver*, irritated by alcohol in the blood, becomes enlarged and choked up ; it no longer purifies the blood by removing those poisonous materials which it separates in health. After a time it becomes much smaller and more solid than in health, and then it does its work still more imperfectly.

321. Alcohol causes the *heart* to act too rapidly, and this organ is changed in a manner so as to interfere with its action. After awhile it may act imperfectly or irregularly. Muscle tissue becomes changed to fat, and the heart being formed of such tissue, suffers a like change. The *blood-vessels* lose their elasticity, become dilated and stiff. Upon the nose

can be noticed how the veins of the drunkard become enlarged and prominent.

322. The *muscles* are made weak, because part becomes changed into fat ; such muscles then become soft.

323. The effects of alcohol are probably shown more prominently upon the *nerves* than upon any other parts of the body. As a result of the irritating effects of the alcohol, the *brain* first becomes excited ; this excitement is soon followed by the opposite condition, and the person becomes dull and stupid. It is sometimes stated that alcohol rouses the brain and enables it to do more and better work ; it has also been stated that certain authors have done their best work when somewhat under the influence of this substance. But such statements are either entirely erroneous or merely show what is exceptional. People who do much brain-work usually agree that they are more active without the use of alcoholics.

324. Alcohol excites the brain in one way, but it is not the most desirable way. It unbridles the tongue and tempts the unhappy victim to say things which he should not say, and which he feels ashamed of afterward. It blunts all the nobler instincts, and lets loose those of an animal nature.

325. The *nerves* soon become affected as a result of alcohol, and the victim is made unsteady, as is shown by the trembling hands and unsteady walk of the drunkard.

326. The *eyesight* may suffer, and even blindness may follow as the result of the poisonous effects of large quantities of alcohol upon the nerve of the eye.

QUESTIONS.

1. What are the effects of alcoholic drink upon the stomach?
2. What effect has a large quantity of alcohol upon the digestion of the food?
3. What are the effects of alcoholic drink upon the intestines?
4. What are the effects of alcoholic drink upon the liver?
5. What are the effects of alcoholic drink upon the purification of the blood?
6. What are the effects of alcoholic drink upon the action of the heart?
7. What are the effects of alcoholic drink upon the heart itself?
8. What are the effects of alcoholic drink upon the muscles?
9. What are the effects of alcoholic drink upon the brain?
10. Can we do better work with the brain after the use of alcohol?
11. How does alcohol excite the brain?
12. How do the nerves become affected as a result of the use of large quantities of alcoholic drink?
13. How does the eyesight sometimes suffer as a result of large quantities of alcoholic drink?

LESSON XXXI.

OTHER HARM WHICH ALCOHOLIC DRINK CAUSES.

327. **Drunkenness.**—When the victim of the alcoholic habit imbibes a sufficient quantity to get himself in a condition in which he is no longer responsible for what he does, we say he is *drunk or intoxicated*. An intoxicated person becomes *stupid in intelligence*, but excited in other ways. If he is naturally cheerful, he will become noisily gay, or attempt to sing in a hoarse manner, or laugh like a fool. If he is usually more serious, he may scold or attempt to make a speech, saying many ridiculous things. If he is usually quarrelsome, he will become very disagreeable; he will fight, and he then becomes *dangerous*.

328. A drunken individual is *unable to control his speech*, is unconscious of what he is saying, and allows his tongue to run away with him. He is unable to walk straight; he *staggers* along in a pitiable way, catching on to lamp-posts, railings, and fences for support. Every part of the body becomes *unsteady* and *trembles*. He forgets that he is a human being and *acts like a brute*. A drunken man is a *disgusting sight*!

329. If drunkenness be repeated many times and becomes a habit, the memory begins to fail, the person becomes bloated and fat, the complexion poor, his

breath offensive, his health fails, and he becomes feeble ; his hands tremble, his eyes and nose are constantly reddened ; he becomes careless and dirty, unfit for any occupation, or any society.

330. The Use of Alcoholic Drinks is Associated with a Waste of Time and Money.—Even the milder forms of alcoholic indulgence are associated with conditions which are well worth considering. There are *millions of dollars uselessly spent* for alcoholic drink each year. How many useful things this immense sum of money would purchase, and how much good it might accomplish ! Consider how much time is wasted in saloons, often in wretched companionship, which might otherwise be given to the family at home.

331. The Alcohol Habit.—Men do not become drunkards at once ; they reach this stage *gradually*. They commence with small quantities of drink. The habit of drinking is formed and grows until larger and larger amounts must be consumed in order to satisfy. The use of alcoholics *creates an appetite or craving for more*. As long as alcohol is in the system, there exists a desire for it ; and the amount necessary to satisfy this longing constantly increases ; an appetite for more alcohol is created and this is frequently almost irresistible. The danger increases because the moral power to resist becomes weakened ; this adds to the seriousness of the condition and leads to drunkenness.

332. It may be argued that many people are in the habit of using moderate amounts of alcoholic drinks

without any apparent injury ; but the same can be said of every other poisonous substance. No one will deny that the *world would be infinitely better off if there was no such thing as alcoholic drink, or even alcohol itself*. Some other substance would undoubtedly be found to take its place. If a prison be visited, and the convicts be asked about the crimes which brought them there, it is astonishing how many of them will ascribe their downfall to *drink*. Many a man, who would otherwise have been a good and useful citizen, has been made a criminal by this poison. It may safely be said that there is *no cause of crime so great and widespread as drink*.

QUESTIONS.

1. What is drunkenness? 2. What effect has drunkenness upon the intelligence? 3. What effect has it upon speech? 4. What effect has it upon the walk? 5. What are the results of repeated drunkenness? 6. In what way is the use of alcoholic drinks associated with waste of time and money? 7. What is meant by the alcohol habit? 8. Why is it so difficult to break the habit of drinking alcoholics? 9. Could we get along if there were no such things as alcohol and alcoholic drinks? 10. What is probably the greatest cause of crime?

-

LESSON XXXII.

NARCOTICS.—TOBACCO.

333. **Narcotics.**—Certain drugs which benumb the body, relieve pain, and produce sleep are called narcotics. Such drugs are powerful and are *dangerous* when taken improperly. Narcotics benumb the brain, and thus produce an artificial sleep which usually lacks the refreshing qualities of natural sleep, being often followed by a stupid condition and by headache. This is apt to be the case when narcotics are taken carelessly and improperly, and without a physician's advice.

334. The narcotics used most frequently to produce sleep are *opium* and *morphine*. *Tobacco* is a narcotic, but is not used to produce sleep. *Alcohol* is a narcotic when used in large amount; this is seen in a very pronounced manner in the heavy sleep which occurs in dead drunkenness. In some persons, even a small amount of alcoholic drink will act as a narcotic and cause drowsiness; this effect is seen especially after the use of malt liquors.

TOBACCO.

335. Tobacco was first introduced into France in 1560, and in 1586 Sir Walter Raleigh introduced it

into England. Previous to this time it had been used by the American Indians, and was smoked by them when Columbus landed. Tobacco is the leaf of a plant which grows and is cultivated in various parts of the United States and other countries. It is used



FIG. 89.—The Tobacco Plant.

very largely in smoking and chewing ; less in snuffing. Its injurious effects are due to a poisonous principle called *nicotine*.

336. **Effects of Tobacco upon the Body.**—The effects of tobacco upon the body are changed by *habit*. There is a great difference between the effects

produced at first, and those which follow after the body has become accustomed to it. When first used, and in those unaccustomed to it, tobacco produces dizziness, headache, sickness at the stomach, vomiting, weakness, and trembling.

337. After a time the system usually becomes *accustomed* to its use. It then acts, with some persons, as a mild narcotic, having a *quieting effect* upon the body and mind. But this soothing effect is not produced in every user of tobacco. Quite a large number are made uncomfortable by tobacco in any form, even in the smallest quantities, and never succeed in becoming accustomed to it, or in deriving any comfort or satisfaction from its use.

338. **The Tobacco Habit.**—The fondness for tobacco is an *acquired habit*. At first it is probably used merely from a desire to imitate; then it becomes a habit and soon causes a craving which is satisfied only by larger and larger quantities. This habit does not, however, become as firmly rooted as the alcohol habit; nor can the evils resulting from the use of tobacco be compared with those caused by alcohol.

339. It is a disputed question whether the use of tobacco is ever *positively beneficial*. Many adults seem to be able to use tobacco in moderation, *without any apparent ill effects*. But it is also quite certain that a great many individuals are *injured* by it, and *in the case of the young it is unquestionably a poison which causes decided injury*.

340. **Injurious Effects of Tobacco upon Grown Persons.**—Quite a number of grown persons suffer

from the effects of tobacco and consequently from *tobacco-poisoning*. In many cases such symptoms are slight, but in many others they are serious enough to prevent them from using tobacco in any form. The injurious effects of tobacco may show themselves in the following ways :

341. **Smoker's Sore Throat.**—The irritating effect of tobacco smoke often causes a soreness of the throat, known as *smoker's sore throat*. This irritation may extend into the lungs and cause a *cough*.

342. The appetite may suffer and attacks of indigestion may occur. There may be dizziness and faintness from time to time.

343. **Tobacco Heart.**—Numbers of smokers are compelled to give up the habit on account of its producing what is called *tobacco heart*; this is a nervous state of the heart showing itself in palpitation, with too rapid and irregular beating.

344. **Tobacco Blindness.**—As a result of tobacco-poisoning, the optic nerve is sometimes affected and a form of blindness may ensue.

345. **Tobacco Nervousness.**—Nervousness and trembling are frequently the consequences of smoking.

346. **Poisonous Effects of Tobacco upon the Young.**—There is some difference of opinion as to whether the moderate use of tobacco in grown persons who appear to be uninfluenced by it is injurious. But even those who contend that many adults are not injured by the moderate use of tobacco, are unanimous in stamping it as *one of the most poisonous and*

injurious practices, when indulged in by young and growing persons. It checks their growth, weakens the body, and impairs both muscular and mental activity. Of this there can be no doubt. Some of the States have very wisely passed laws forbidding the sale of tobacco to young people.

347. **Cigarette Smoking.**—This is probably the most injurious form of using tobacco. Cigarettes are usually made of the very poorest stuff. Being common and cheap, they are brought within the reach of boys, and in this way tobacco tempts and injures the young in the most insidious manner. While a smoker of a cigar or pipe simply draws the smoke into the mouth and then expels it, the cigarette smoker usually *inhales* it—that is, he draws it into his lungs. This practice is not only irritating to the lungs, but much more of the poisonous nicotine is absorbed than when the smoke is simply drawn into the mouth and then puffed out. The paper with which cigarettes are made is another objectionable feature, its smoke being harsh and irritating.

348. **Other Objections to the Tobacco Habit.**—The use of snuff is a *filthy* habit which is not as prevalent now as it used to be; it is apt to injure the sense of smell and to keep the nose and throat in an irritable and unhealthy condition. Chewing tobacco is a *disgusting habit* which makes the breath foul, discolours the teeth, and is accompanied by the dirty practice of spitting.

349. Even under the most favorable circumstances a number of objections, based upon abuse of the sense

of cleanliness, can be urged against smoking. The smell of tobacco-smoke becomes stale and clings to the hair and the clothing. The teeth, and frequently the fingers, become discolored. The breath cannot be sweet, and the atmosphere of our houses is more or less vitiated. To many persons the smoke of tobacco is *offensive*, and some are even made sick by it; smokers are very apt to forget this and their good manners, and to subject such persons to great annoyance.

QUESTIONS.

1. What are narcotics? 2. Why should they never be used without the advice of a physician? 3. Which narcotics are used most frequently to produce sleep? 4. Under what circumstances is alcohol a narcotic? 5. What can you say concerning the early history of tobacco? 6. What poison does tobacco contain? 7. What are the effects of tobacco upon one who is unaccustomed to it? 8. In what favorable way may it act upon certain persons after they become used to it? 9. Does it have this soothing effect upon everybody? 10. How is the tobacco habit formed? 11. Is the use of tobacco ever positively beneficial? 12. In what manner does tobacco always act upon the young? 13. What are some of the injurious effects of tobacco in grown persons? 14. What is meant by smoker's sore throat? 15. What is tobacco heart? 16. What is tobacco blindness? 17. What is tobacco nervousness? 18. Is there any difference of opinion regarding the poisonous effects of tobacco upon the young? 19. What effect has tobacco upon the young? 20. Why is cigarette smoking the most injurious form of using tobacco? 21. What can you say regarding the use of snuff? 22. What can be said regarding the practice of chewing tobacco? 23. What other objections can be urged against the use of tobacco?

LESSON XXXIII.

OPIUM AND MORPHINE.

350. **Opium and Morphine.**—Opium is a narcotic, but is probably the most useful medicine there is when ordered by the doctor in proper cases. It is a brown, sticky substance, or it may come in the form of a brown powder. It is *very poisonous*. Most of it comes from India and the warm countries of that region. It is the juice of the unripe fruit of the poppy-plant; this juice is allowed to dry, and then forms this sticky substance. From this is extracted white crystals, which have the same effect on the body as opium itself; these crystals are called *morphine*.

351. **Fluid Forms of Opium.**—Opium dissolved in alcohol and water is called *laudanum*. *Paregoric* is another medicine which has opium in it; a great many persons do not know this, and are very careless in giving this medicine to babies and to children.

352. **The Opium or Morphine Habit.**—Everyone has probably heard of the *opium habit*, or, what is the same thing, the *morphine habit*. It is a habit people get into of taking these drugs whether they need them or not. Morphine and opium take away pain, and make persons sleep when they are sick and restless; in such cases they do a great deal of good.

353. But persons who have the morphine or opium

habit do not take the drug for this purpose, but because they think it makes them feel good for the time being, and makes them forget any cares they may have. But after the effects pass off, they feel miser-



FIG. 90.—The Opium Plant.

able. The stomach is upset, they are tired and nervous, have a very bad headache, and often feel like vomiting. They feel so bad that they take more and more, until finally they keep under the effects of it all the time. Some of them take the narcotic by the mouth, others smoke it in long pipes.

354. There is still another way in which these wretched people take morphine, and that is by piercing the skin with a hollow needle. Some of the morphine, dissolved in water, is forced under the skin from a small glass tube which is attached to the hollow needle. This is probably the most dangerous way of taking the drug, when used merely as a habit.

355. Many persons who have this horrible habit have *commenced very innocently*. Their doctor may have ordered the drug for them at a time when they needed it. But instead of stopping its use when they were well, perhaps they have continued it, imagining it made them feel better, until it was too late, and they were prisoners of the habit. It is a habit which is very difficult to break off; it is said to be even more difficult to stop than either drinking or smoking.

356. The *effects* of the opium and morphine habit upon the health show themselves very soon. The poor wretch soon becomes nervous; he cannot sleep at night; he has no appetite; if he takes any food he cannot digest and often vomits it; he becomes thin and has a yellow complexion; his mind changes and he loses his memory; he has no longer the power to do right, and he is known to tell lies without hesitation in order to get some of the drug; he becomes worse and worse, until, finally, when he has no more money to buy the drug, and his health is all broken up, he dies in the hospital or lunatic asylum, or often commits suicide. This is a horrible picture that has been drawn, but a true one.

QUESTIONS.

1. What is opium? 2. What is morphine? 3. What is laudanum? 4. What is paregoric? 5. Is morphine or opium harmful when prescribed by the doctor? 6. What is meant by the opium or morphine habit? 7. What disagreeable effects follow the use of opium or morphine taken from habit? 8. How do persons sometimes begin this habit? 9. In what different ways is the drug used? 10. What effect has the opium and morphine habit upon the health? 11. How do such persons frequently end their lives?

LESSON XXXIV.

THE BRAIN, SPINAL CORD, AND NERVES.

357. These parts (Figs. 91 and 92) give us information of the condition of the body and of what is going on around us, so that we can do what is best and avoid danger. It is also their work *to connect the different organs of the body* so that they will work in harmony. They enable us to feel, think, see, hear, etc., and in this way we avoid injury.

358. When a large number of persons are working separately there must always be a head or chief to direct them. Imagine what disorder there would be in the class-room if every pupil did as he or she wished and there were no teacher. Think of an army of soldiers, over which there was no general, and every soldier did as he wished ; how dreadful the confusion would be ! In the same way there would be great disorder among the organs of our bodies if there was not something to connect them and to direct their work ; this is done through the brain, spinal cord, and nerves.

359. The brain is the *chief* that superintends the entire work of the body. It is situated in the skull.

360. Next, there is an addition to the brain called the *spinal cord*. It is a sort of *assistant* to the brain. The spinal cord runs in the canal or tunnel in the backbone.



FIG. 91.—The Brain, Spinal Cord, and Nerves.

361. Finally there are the *nerves*. These are tiny threads connecting the brain and spinal cord with different parts of the body. They are the *messengers* or telegraph wires, so to speak, which carry the wishes of the brain to different parts of the body; they also carry messages from different parts of the body to the brain.

362. **How the Brain, Spinal Cord, and Nerves Act.**—The action of these parts can best be understood by an example. Suppose a man is walking along the street and is about to cross the car-track. His ear hears the jingle of the bells and by means of a nerve sends a message to the brain; the brain then sends an order along the nerves of the eyes to these organs to look in the direction in which the ear has heard the sound and to see whether a car is approaching. The eyes obey the orders of the brain and look and see the car very near, and also perceive that the person is in danger of being run over. They immediately send back word to the brain about this danger. Then the brain sends word to the muscles which move his legs; this message is also transmitted by nerves; it tells these muscles to act immediately. The result is that they obey; he quickens his steps and thus escapes the coming car.

363. **This Action is Very Rapid.**—All these messages are sent back and forth with lightning-like rapidity, and it only takes a very small part of a second for a message to travel from the tip of the finger to the brain and back again.

364. **The Brain.**—The brain is a large, rounded



FIG. 92.—The Brain and Spinal Cord.

mass of soft tissue which is contained in the oval box of bones formed by the skull (Figs. 91 and 92). Being surrounded by these flat bones, it is protected from injury. The brain can be divided into two halves (Fig. 93). When we look at it under the microscope, we

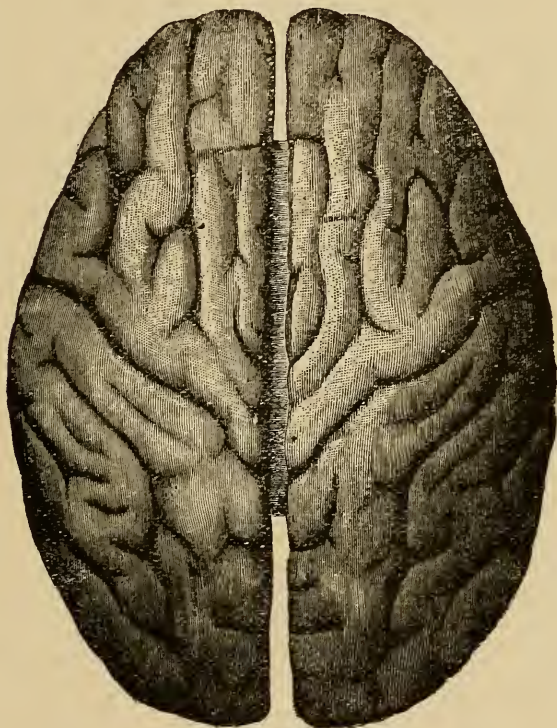


FIG. 93.—The Brain.

find that it consists of millions of threads or fibres, called *nerves*, and of little bodies called *cells*.

365. **The Nerves.**—The brain and spinal cord give off a large number of nerves which pass to different parts of the body. There are small holes in the skull and backbone by which these nerves pass out.

366. **Kinds of Nerves.**—Some of the nerves give

feeling to different parts of the body, and especially to the skin. When you cut or burn yourself, it is one of these nerves which carries the message of pain to the brain. Other nerves go to the different *muscles*, and cause them to act when the brain wishes it.

QUESTIONS.

1. Of what use are the brain, spinal cord, and nerves?
2. Give an example to show that there must be a chief or head to everything where there are many parts.
3. Where is the brain?
4. Where is the spinal cord?
5. What relation has it to the brain?
6. What are the nerves?
7. What is their work? Give an example to show the action of the brain, spinal cord, and nerves.
9. Is this action slow or rapid?
10. Of what is the brain formed?
11. How is the brain protected from injury?
12. How can the brain be divided?
13. In what manner do the brain and the spinal cord give off nerves?
14. What two kinds of nerves are there?

LESSON XXXV.

THE WORK OF THE BRAIN, SPINAL CORD, AND NERVES.

367. The Brain Renders us Superior to the Lower Animals.—The lower animals accomplish different actions through what we call *instinct*, that is, without the action of the mind. But we can do many more things than they, and more difficult acts, because our brains are more developed.

368. The Work of the Brain.—Let us examine the work of the brain and see what it does for us. In the first place, it is where the *will* exists; it is where our desires come from. Then as to *memory*, it is the brain which enables us to *think* about things and to *remember* names, figures, faces, and all other things. Think of the wonderful action of the brain when it is possible for us to remember things all our lives!

369. Intelligence.—Intelligence has its seat in the brain. This prevents us from being stupid; and enables us to understand things and to express ourselves just as we wish by language. It enables us to see the difference between right and wrong, so as to avoid the latter.

370. Training of the Brain.—Much of our memory and intelligence depends upon the way in which our brain is trained. If we use our brain a great deal,

it will become better than if we allow it to remain idle. Many things which we study at school are taught us for the purpose of training the brain. We should remember that we cannot think of more than one thing at a time. When you study your lessons, you should not think of play; and when you play, you should enjoy yourself, and need not think of your studies. There is a time for play and a time for study.

371. Sleep.—Sleep is the *natural rest of the brain*. Just as every other part of the body needs rest during each twenty-four hours, so does the brain. We may rest any other part of the body without sleep; but the only sign that the brain is resting completely and is not active is sleep.

372. Children Require Plenty of Sleep.—The amount of sleep which is necessary varies with different people. Men who think a great deal require more than those who do bodily work. The average sleep necessary for most men is from *seven to eight hours*. Children require more sleep and should have from *nine to ten hours*, for while the body is growing rapidly more rest is needed.

373. The Proper Time for Sleep.—*Night is the time for sleep.*—Young people who dance all night or until late at night and then sleep by day, soon look pale and tired out, and often weaken their bodies so much that they become sick. The proper time for children to go to bed is from eight to nine o'clock; they should then rise at six or seven.

374. The Effects of Alcoholic Drink upon the Brain and Nerves.—The brain and nerves have a

great enemy in alcohol. If a large quantity of alcoholic drink is taken at one time, and the person becomes intoxicated, he becomes stupid in his intelligence, but excited in other ways—he sings, or cries, or begins to laugh like a fool, or begins to scold, and often fights. He forgets that he is a human being and acts like a brute. He is unable to walk straight and staggers along in a pitiable way, catching on to lamp-posts or any other place for support. The effect upon the nerves is shown by the way every part of his body trembles, and by his great unsteadiness. A drunken man is a disgusting sight! If his drunkenness be repeated many times and becomes a habit, the memory begins to fail, the person becomes bloated and fat, but very weak, his health fails, his hands tremble, his eyes and nose are constantly bloodshot, he becomes dirty and careless, and the individual changes into a good-for-nothing.

375. As a result of drunkenness there is often produced a disease of the nerves in which the victim is out of his mind. It is a condition which kills many men, and which is dangerous to the drunkard and to those who are around him; he tries to do all sorts of violent things, especially to jump out of the window. He imagines that he sees animals, such as mice, rats, and snakes, and he thinks these are chasing him, and he wants to run away. It is difficult to keep him quiet. The whole body trembles from the poisonous effects of the alcohol. The heart is often weakened so much that the person dies because this organ has become too weak.

376. Effect of Tobacco upon the Nerves.—

This shows itself chiefly by the trembling hands and the nervousness which we often notice in persons who smoke a great deal. Many persons, especially young men, cannot smoke at all without nervousness. *Boys are always made nervous by tobacco.*

377. Effects of Coffee and Tea upon the Nerves.—Coffee and tea excite the nerves. They are often the cause of nervousness and trembling; also of palpitation of the heart, which is a form of nervousness. Children are better off without coffee or tea; milk is a much better drink for growing bodies.

QUESTIONS.

1. What do we mean when we say the lower animals accomplish different actions by instinct? 2. Which is the more developed, the brain of man or that of the lower animals? 3. What does the brain do for us? 4. Where does the will exist? 5. What enables us to think of things? 6. What is memory? 7. What is the seat of intelligence? 8. What is intelligence? 9. How can we train the brain? 10. Why is sleep necessary? 11. What effect has sleep upon the brain? 12. How much sleep do grown persons usually require? 13. How much sleep do children require? 13. What is the proper time for sleep? 14. When should children retire? 15. What are the effects of alcoholic drink upon the brain and nerves? 16. What disease of the nerves does drunkenness often produce? 17. What effect has tobacco upon the nerves of many persons? 18. What effect has tobacco upon boys? 19. In what injurious way do coffee and tea often act upon the nerves? 20. What is a better drink for children than coffee and tea?

LESSON XXXVI.

THE FIVE SENSES.—THE SENSE OF SIGHT—THE EYE.

378. **The Five Senses.**—There are certain organs in the body which add a great deal to our comfort and give us knowledge and pleasure. The duties of these organs are called the *senses*. There are five of them :

1. Sight—The eye.
2. Hearing—The ear.
3. Smell—The nose.
4. Taste—The tongue.
5. Touch—The skin.

THE SENSE OF SIGHT—THE EYE.

379. **How the Eyes are Protected.**—The eye is one of the most delicate organs in the body. It is protected by being placed in the large opening in the skull just below the forehead, on each side of the nose. Besides this, it is also protected by the *eyebrows*, *eyelids*, and *eyelashes*, which keep out dust and exclude the light when too strong, or during sleep.

380. **Parts of the Eye** —The eye is spherical in shape (Fig. 94), and measures about an inch in diameter. Its front portion is perfectly transparent, but behind it is opaque and white.

381. Looking into the eye we see in the centre a black spot which is called the *pupil*. It is a round opening in a colored curtain. The pupil changes its size very often. It regulates the amount of light which should enter the eye. In going into a bright light, as, for instance, into the sunlight, the pupil be-

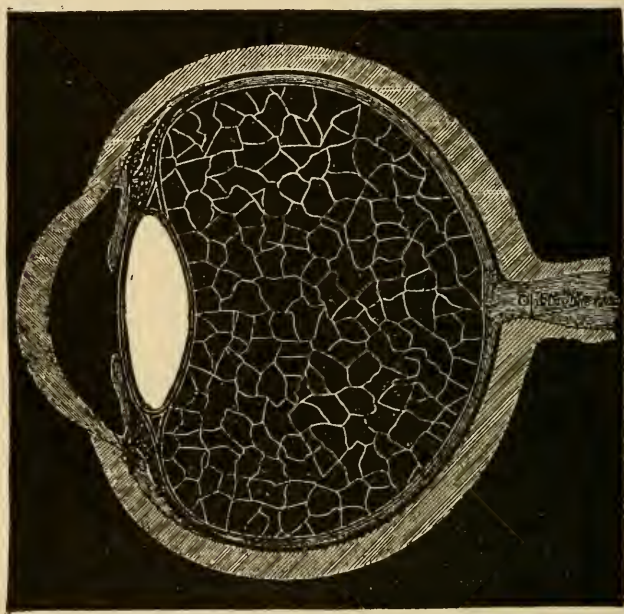


FIG. 94.—The Eye (cut Across and Enlarged).

comes very small ; if it did not do so, the light would be too bright and would injure the eye.

382. Behind the curtain of the eye is a round transparent body, about the size of a cherry-pit, which is called the *lens*. It is perfectly clear, and its shape is like that of a small magnifying-glass ; but it is softer, like a hard jelly.

383. The interior of the eye is partly filled with

fluid. Just behind the clear part, and extending to the lens, is a space which is filled with a watery fluid. The rest of the eyeball (behind the lens) is filled with a clear jelly-like substance. All these parts are shown in Fig. 94.

384. **The Muscles of the Eye.**—The eyes are able to move in every direction ; this is necessary to protect the body. There are six small *muscles* attached to each eye, which enable it to move very rapidly (Fig. 95).

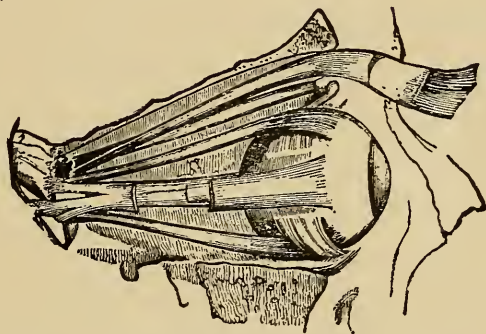


FIG. 95.—The Muscles which Move the Eye.

385. **The Eye Resembles a Photographer's Camera.**—Let us see how the eye resembles the box which the photographer uses to take pictures, and which is called a *camera*. In the first place the photographer cannot take a picture in the dark, nor can we see in the dark. Secondly, in the front of the camera there is a lens of glass ; we also have a lens, though it is of course not of glass, but of a better and softer material. Again, in the back of the photographer's camera there is a glass plate, upon which the picture falls and is taken ; in the same way in our eyes a layer of nerves serves as a plate upon which to take

the picture. Anything which we see forms an image upon this layer of nerves. This image lasts only a short time, but long enough for us to see it. Finally, you have probably noticed how the photographer puts a black cloth over his head and the back of the camera so as to keep it dark ; there is also a dark, colored coat in the interior of the eye which serves to darken it.

386. The Nerve of the Eye.—Connected with the back of the eye is a portion resembling a cord, which passes to the brain. This is the *optic nerve*, or nerve of the eye, and connects the eye with the brain.

387. The Tears. — The eye is constantly kept moist by being bathed with *tears*. Even during sleep this takes place, though there is then much less produced. When we are awake, the constant movements of the eyelids spread the tears over the eyes. After the tears have moistened the eyes they are collected again, and escape into the nose by means of a tube.

QUESTIONS.

1. Name the five senses.
2. What are the uses of the senses?
3. How are the eyes protected?
4. How are dust and light kept out of the eyes?
5. Describe the different parts of the eye.
6. What is the pupil of the eye?
7. Of what use is the pupil of the eye?
8. How does the pupil of the eye change its size?
9. What is the lens of the eye?
10. What is there in the interior of the eye?
11. How are the eyes moved?
12. In what ways does the eye resemble the photographer's camera?
13. Where is the nerve of the eye?
14. With what other part of the body does the optic nerve connect the eye?
15. How are the eyes kept moist?
16. What becomes of the tears after they have moistened the eyes?

LESSON XXXVII.

THE CARE OF THE EYES.

388. There is no organ in the body which contributes so much to our comfort, our enjoyment, and our knowledge, as does the eye. And yet the eye is being constantly misused. Some of the most common *rules for the care of the eyes* are the following :

389. After having read a long while it is well to stop and *rest the eyes* ; for the eyes, like any other part of the body, cannot be used continuously.

390. *Never read in a poor light.*

391. *Never read very fine print*, or poor print, if you can help it.

392. *Do not stoop when you read.* Place the book in such a position that you can read comfortably with the head erect (Figs. 96 and 97).

393. In reading, have the *light come over your shoulder* and thus fall upon the book or paper without going directly into the eyes. It is better to *sit with your back to the window* and thus have the light come over your shoulder, and preferably over the left shoulder. This precaution is especially useful at night, for the glare of the gaslight or lamp is very tiring to the eyes. If the light is behind and above you and falls over your shoulder, there is more light upon your book or paper, and yet the eyes are spared the brightness.

394. *Never read while lying upon the back.* This causes a great strain upon the eyes.

395. There may be some excuse for business men's *reading in the cars*, for often this may be the only time they have to read the daily papers. But there is no reason why children should do this. It is injurious, in the first place, because the light is usually poor, but chiefly, because the constant jolting of the



FIG. 96.—The Correct Position in Reading



FIG. 97.—Faulty Position in Reading.

car makes the page unsteady and requires a constant strain upon the eyes to keep the place.

396. *Never wash your eyes with water which another person has used on his face.* Never use a towel, for wiping your face, which another person has had to his face, unless this person is one of your family and you know he has no eye disease. There is a disease of the eyelids, called *granular lids*, which is very contagious; many children contract it by using the

towel or handkerchief which another child who had the disease has used.

397. Effect of Alcoholic Drink upon the Sight.

—The use of large quantities of alcoholic drink has a very bad effect upon the sight and may lead to blindness. There is a disease of the optic nerve, the nerve of the eye, which is due to poisoning from alcohol.

398. Effect of Tobacco Poisoning upon the Sight.—When the body becomes poisoned from the use of tobacco, the nerve of the eye may become diseased and a failing of the sight or blindness similar to that produced by alcohol may result.

QUESTIONS.

1. Why is it well to rest the eye after having read for any length of time? 2. What position should you assume in reading? 3. From which direction should the light come in reading? 4. Why is it well to have the light come from over the shoulder? 5. Ought we to read while lying upon the back? 6. Why not? 7. Why is it injurious to read in cars? 8. What precautions should we take so as to avoid contracting disease of the eyelids from another person? 9. What injury to sight sometimes follows the use of large quantities of alcoholic drink? 10. What similar effect sometimes follows poisoning from tobacco?

LESSON XXXVIII.

THE SENSE OF HEARING.—THE EAR.

399. Like the eye, the ear is an organ which adds very much to our comfort, pleasure, and knowledge.

400. **Parts of the Ear.**—The ear is divided into three parts: An *outer*, a *middle*, and an *inner*.

401. **The Outer Ear.**—This part is seen at the side of the head (Fig. 98). Its shape is not only ornamental but useful, for it serves to collect the sound and lead it into the deeper parts of the ear. From this outer part of the ear there is a *canal* (Fig. 99), about an inch long, which leads to the next part, the *middle ear*. In this canal is usually found a little yellowish substance, called *ear-wax*, which serves to keep the canal soft and moist.

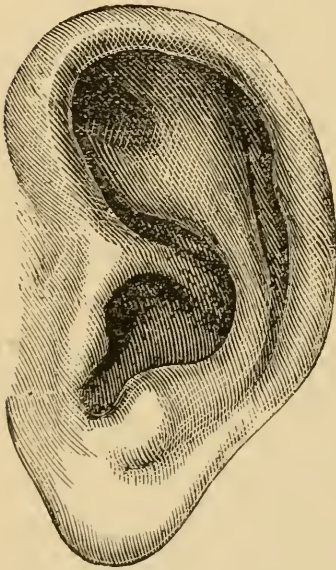


FIG. 98.—The Outer Ear.

402. **The Middle Ear.**—The middle part of the ear is at the bottom of the canal which leads from the outer ear (Fig. 99). Between the two a sheet of membrane is stretched, which is called the *drum-membrane*. In the middle

ear itself there is nothing but three small *bones*, which are joined so as to form a chain.

403. The Ear and the Throat are Connected.

—Perhaps you may have noticed that when you blow your nose very hard there is sometimes a stuffed feeling in the ears. This is because air has entered the ear by means of a *tube* which runs from the throat to the middle ear (Fig. 99).

404. The Inner Ear.—This part of the ear is placed

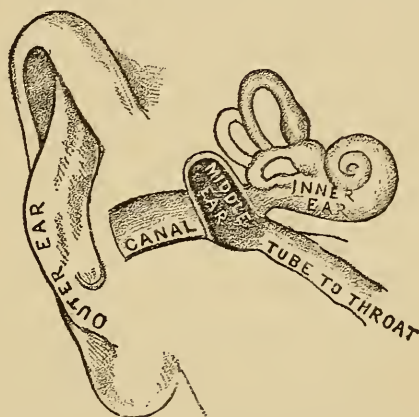


FIG. 99.—The Different Parts of the Ear.

very deeply in the bone. There are several circular canals and a staircase hollowed out of the bone, and in these the inner ear is contained (Fig. 99).

405. The Nerve of Hearing.—The nerve of hearing is attached to the inner ear, and from this part it passes to the brain. It conducts sound to the brain just as the nerve of the eye conducts sight to the brain.

406. Sound.—Before studying how we hear, it is necessary to understand *how sound is produced*. Sound is produced whenever the air is made to *vibrate*

—that is, whenever the air is put into motion resembling waves. You will understand this better if you think for a moment of the water: Suppose when a pond is quiet, you throw in a stone; this causes a motion in the water and you will then see rings start out from the point where the stone fell, these rings becoming larger and larger until they are finally lost; but all the time these rings, or very small waves, have been going farther and farther from the centre. Now imagine the same thing occurring in the air. If you strike a bell, for instance, you know that the bell is vibrating, because if you put your finger on it you can feel this motion. This motion is given to the air, and the air vibrates in the same way, except that the vibrations travel through the air to our ear.

407. **How We Hear.**—The waves of sound pass through the air and reach the outer ear which leads them into the canal to the drum-membrane. Beating against this membrane they cause it to vibrate; this sets the bones of the middle ear in motion and they carry the vibrations to the inner ear, and the nerve of hearing carries the sound to the brain.

408. **Care of the Ears.**—We should never *try to pick out the wax* in the ears with hairpins and other sharp instruments. A little wax is quite natural, and if too much is there it is best to let the doctor remove it, for we may injure the delicate parts of the ear.

409. A *blow* upon the side of the head or over the ear is *dangerous*, because it sometimes affects the brain; it may also tear the delicate drum-membrane and thus interfere with good hearing.

QUESTIONS.

1. Into what parts can we divide the ear? 2. Where is the outer ear? 3. What is its use? 4. Where is the canal of the ear? 5. Where is the middle ear? 6. Where are the bones of the ear? 7. What is the drum-membrane? 8. How are the ear and the throat connected? 9. Where is the inner ear? 10. What parts are connected by the nerve of hearing? 11. How is sound produced? 12. Explain how we hear. 13. Ought we to pick out the ear-wax? 14. Why is a blow upon the side of the head or over the ear dangerous?

LESSON XXXIX.

THE SENSE OF SMELL.—THE NOSE.

410. The nose is the organ with which we *smell*. It is also the part through which the *air* is drawn.

411. **The Breathing Channel and the Smelling Channel.**—When we *breathe*, we draw the air *backward* through the lower part of the nose. When we *smell*, we draw the air *upward*, because we want the odor to ascend to where the nerves of smell are (Figs. 100 and 101).

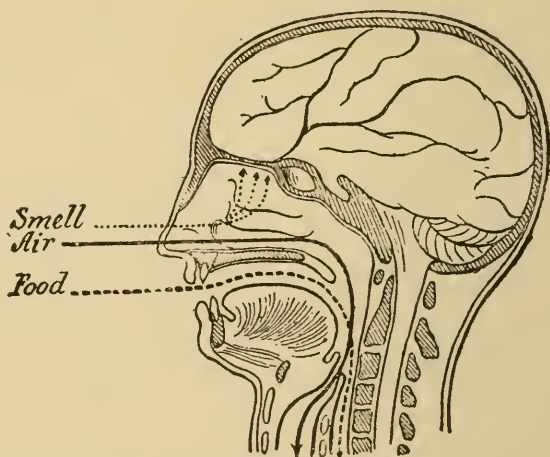


FIG. 100.—The Routes by which Air, Food, and Smell enter the Body.

412. **Parts of the Nose.**—The hard part of the nose on the outside, where usually people wear their eye-glasses, is formed of two small bones and is called the *bridge* of the nose. In looking into the nose we

find that it is divided into two halves. The openings in front are called the *nostrils*.

413. **The Nerves of Smell.**—The brain lies immediately above the nose. The *nerves of smell* come in bunches from the brain and descend into the nose (Fig. 101). They serve to carry odors to the brain.

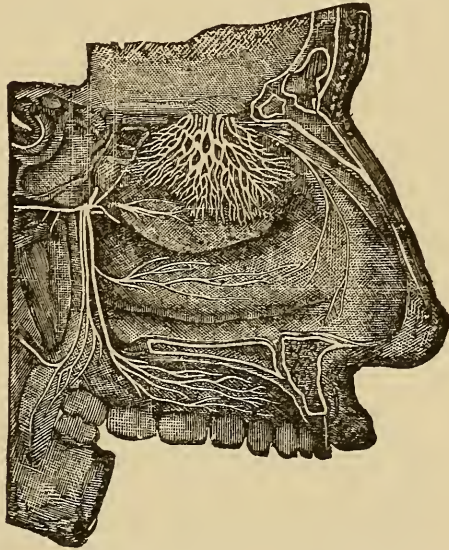


FIG. 101.—The Interior of the Nose, Showing also the Nerves of Smell.

414. **Uses of the Sense of Smell.**—With the sense of smell we are able to enjoy agreeable odors. But what is important is, that we are also able to smell *bad odors*, thus *protecting* the body by informing us of the whereabouts of obnoxious things which should be avoided, especially of *impure air*. It enables us to *select* the proper *food*, and to refuse that which is unfit to eat. It often protects our bodies and homes by enabling us to smell smoke, and in this way to discover the existence of a fire.

415. **Perfume.**—Many persons use *perfume* to put upon their handkerchiefs and clothes so that they may smell sweet ; but, as a rule, the most refined people do not use perfumes. If you always keep the body clean and brush your teeth, you will not need any perfume ; for if the body is clean, it always smells sweet. *Soap and water* are better than perfume for tidy people.

QUESTIONS.

1. What are the uses of the nose? 2. Through what part of the nose do we breathe? 3. Through what part of the nose do we draw the air in smelling? 4. What part of the nose is called the bridge? 5. Where are the nostrils? 6. Where are the nerves of smell? 7. To what part do they carry the odors? 8. What are the uses of the sense of smell? 9. What can you say in regard to the use of perfume upon the clothes and handkerchief?

LESSON XL.

THE SENSE OF TASTE.—THE TONGUE.

416. The tongue is the organ with which we *taste* our food. It consists almost entirely of *muscle* tissue. Its under surface is smooth and its upper surface very rough. This roughness is due to a large number of

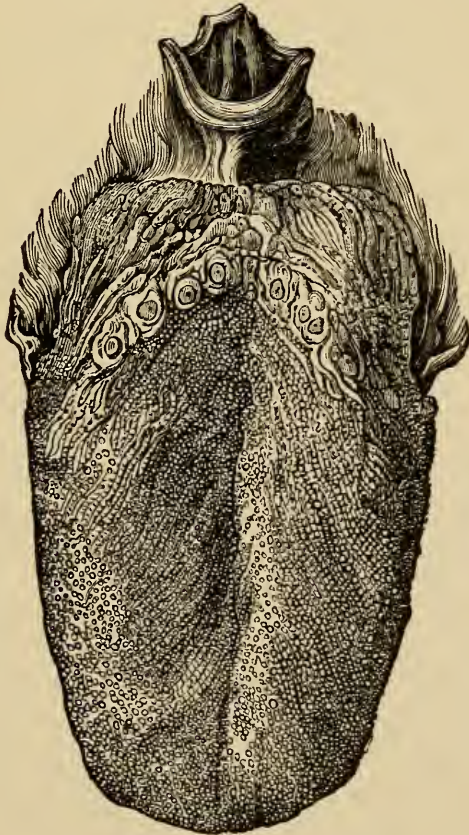


FIG. 102.—The Tongue.

small *projections* (Fig. 102). These are the parts which give us taste. The *nerves* of taste end here. They also enable us to feel the food in our mouth and to discover whether it is chewed sufficiently fine, and mixed enough with the saliva before it is swallowed.

417. **Uses of the Tongue.**—The tongue is the organ of *taste*. It is also used to revolve the food in the mouth, to mix it with the *saliva*, and to assist in *swallowing*. Finally we use the tongue in *speaking*. The sense of taste is very important. It enables us to choose our food and to avoid what is unfit to eat; it prevents us from eating improper food; it increases the appetite and makes us enjoy our meals when the food is to our liking.

418. But though the sense of taste adds much to our enjoyment, it is necessary to prevent it from taking too many liberties, otherwise we shall be eating too much, become gluttons, and suffer in health.

QUESTIONS.

1. How does the under surface of the tongue differ from the upper surface? 2. Why is its upper surface rough? 3. What are the uses of these projections? 4. Where do the nerves of taste end? 5. What are the uses of the tongue?

BROWN'S SERIES

OF

ENGLISH GRAMMARS

THOROUGHLY REVISED

BY HENRY KIDDLE, A.M.,

LATE SUPT. OF SCHOOLS OF NEW YORK CITY.

AS the PUBLISHERS OF BROWN'S GRAMMARS, we take pleasure in announcing that these POPULAR STANDARD TEXT-BOOKS have been THOROUGHLY REVISED AND ADAPTED TO THE PRESENT EDUCATIONAL DEMANDS.

THEIR SUPERIORITY CONSISTS IN

Practical Language Lessons.

Clearness and Methodical Arrangement.

Fullness of Grammatical Detail.

Complete Elaboration in all the Several Parts.

A Logical Accuracy and Perfectness of Definition.

Forms and Formulas of Analysis, Syntactical Resolution and Correction, as Exact and Exhaustive as the Demonstrations of Geometry.

Definite Presentation of the Subject-Matter.

CORRESPONDENCE SOLICITED.

WILLIAM WOOD & COMPANY, PUBLISHERS,

NEW YORK.

BROWN'S GRAMMARS.

The Standard Authority in the Correct Use of the
ENGLISH LANGUAGE.

The School Series comprises :

BROWN'S LANGUAGE LESSONS,

170 pages.

THE FIRST LINES OF ENGLISH GRAMMAR,

156 pages.

THE INSTITUTES OF ENGLISH GRAMMAR,

345 pages.

A VALUABLE BOOK OF REFERENCE.

THE GRAMMAR OF ENGLISH GRAMMARS,

With an Introduction, Historical and Critical,

BY

GOOLD BROWN.

TENTH EDITION—REVISED AND IMPROVED.

WILLIAM WOOD & COMPANY, PUBLISHERS,

NEW YORK.

